University of Padova

School of Science

CATALOGUE OF COURSE UNITS HELD IN ENGLISH

FOR ERASMUS, FOREIGN AND ITALIAN STUDENTS

academic year 2014 > 2015

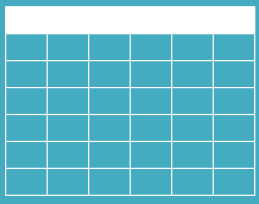
FIRST-CYCLE DEGREES WITH SOME COURSE UNITS HELD IN ENGLISH

Chemistry
Optics and Optometry

SECOND-CYCLE DEGREES WITH SOME COURSE UNITS HELD IN ENGLISH

Astronomy
Evolutionary Biology
Marine Biology
Sanitary Biology
Industrial Biotechnology
Chemistry
Industrial Chemistry
Physics
Geology And Technical Geology
Computer Science
Mathematics
Materials Science
Natural Science
Statistical Sciences
Molecular Biology

First-cycle degree = Bachelor degree
Second-cycle degree = Master degree



FOR COURSES BASED ON A SEMESTER ORGANIZATION

First semester: October 1st, 2014 to January 24th, 2015
Winter exams session: January 26th, 2015 to February 28th, 2015
Second semester: March 2nd, 2015 to June 12th, 2015
Summer exams session: June 15th, 2015 to July 25th, 2015
Extra exams session: August 24th, 2015 to September 23th 2015

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Catalogue of course units held in English

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ERASMUS SECOND-CYCLE DEGREES

1. ASTROMUNDUS
www.astro.unipd.it/astromundus
2. ALGANT
(Algebra, Geometry And Number Theory)
http://lauree.math.unipd.it/algant/node/4

SECOND-CYCLE DEGREES WITH A PROGRAM OF COOPERATION WITH OTHER EUROPEAN UNIVERSITIES FOR COMMON DEGREES

An agreement between the University of Padova and the French Universities Paris Diderot-Paris 7 and Paris Descartes. has been established since the academic year 2010-11 for the release of a common degree between the Second-cycle degree in Molecular Biology and the Master de Sciences Santé et Application. This project requires the mobility of students (up to 6 per year) within the ERASMUS program. More information is available on http://biologia-molecolare.biologia.unipd.it/organizzazione-ccs/socrates-erasmus/

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ENVIRONMENTAL IMPACT AND LIFE CYCLE ASSESSMENT

ENVIRONMENTAL IMPACT ASSESSMENT

ENVIRONMENTAL MINERALOGY

ETHOLOGY

EVOLUTION AND CONSERVATION

FUNCTION THEORY

FUNCTIONAL ANALYSIS 2

FUNCTIONS OF SEVERAL COMPLEX VARIABLES

GALAXY DYNAMICS

GENETIC DISEASES AND MODEL SYSTEMS

GENOMICS

HIGH ENERGY ASTROPHYSICS

HUMAN PHYSIOLOGY

IMMUNOLOGICAL BIOTECHNOLOGY

INORGANIC CHEMISTRY FOR ADVANCED TECHNOLOGY

INTRODUCTION TO GROUP THEORY

INTRODUCTION TO QUANTUM ELECTRODYNAMICS

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LARGE-SCALE CELL CULTURES AND BIOMOLECULES PRODUCTION

MATERIALS FOR ENERGETICS

METAMORPHIC PETROLOGY

MOLECULAR BIOLOGY OF DEVELOPMENT

MOLECULAR ECOLOGY AND DEMOGRAPHY OF MARINE ORGANISMS

MOLECULAR EVOLUTIONARY GENETICS

MORPHODYNAMICS OF LAGOONS, DELTAS AND ESTUARIES UNDER CLIMATE CHANGE

NANOBIOTECHNOLOGY

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NUMBER THEORY 1

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PHYSICAL METHODS IN ORGANIC CHEMISTRY

PHYSICAL METHODS IN ORGANIC CHEMISTRY

REPRESENTATION THEORY OF GROUPS

RINGS AND MODULES

SEDIMENTOLOGY

STATIC ANALYSIS AND SOFTWARE VERIFICATION

STATISTICAL METHODS FOR PROGRAMME EVALUATION

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STRATIGRAPHY

SUPERCONDUCTING MATERIALS

SYMPLECTIC MECHANICS

THEORETICAL CHEMISTRY

THEORY AND METHODS OF INFERENCE

THEORY OF FUNDAMENTAL INTERACTIONS

WIRELESS NETWORKS

ADVANCED CORPORATE FINANCE

Second-cycle degree in Statistical Sciences
Language: English
Teaching period: first semester
Lecturer: Giacomo Boesso
Credits: 8 CFU/ECTS

1

Prerequisites
Business Administration or Introduction to Business
Basic Financial Accounting

Programme
Trend and market analysis
Fefinition of the value proposition
Demand analysis
Offer analysis
Operative analysis
Risk analysis
Financial end Economic feasibility
Value analysis
Scenarios analysis
Social Sustainability

Examination
Individual and group assignements.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2009/000ZZ/1094802

ADVANCED OPTOMETRY AND CONTATTOLOGY

First-cycle degree in Optics and Optometry
Language: English
Teaching period: second semester
Lecturer: Marino Formenti
Credits: 6 CFU/ECTS

2

Programme
Behavioral Optometry
Philosofy
The behavioral approach to vision care
The optometric visual analysis: classical vs behavioral visual exam

Vision and Stress
Nearpoint visual demands
Autonomic visual response to stress agents
Organism Stress response
Stress response in the visual function
Symptoms and signs of visual stress
Development of refractive errors and visual dysfunctions in response to visual stress

Optometric Evaluation of learning problems
Developing lerning readiness
Learning related vision problems
Visuo-perceptual-motor optometric evaluation

Myopia Control
Refraction in worlwide pediatric population
Myopia and environment
Effect of urbanization
Concept and importance of peripheral refraction
Optic defocus theory and philosophy: central vs peripheral vision
Studies in laboratory animals
New concepts in ophthalmic and contact lenses designs for myopia control
Spectacles lens design
Soft lenses: Aspheric, Multifocals

Rigid Gas Permeable: a dynamic application of the sagittal phylosophy

Design
Spherical
Aspherical
Multifocal
Reverse Geometry
Toric

Orthokeratology
History of orthokeratology
Daily wear orthokeratology
Overnight orthokeratology
Orthokeratology design
Corneal changes
How it works
Guidelines and protocol

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1168/2009/000ZZ/1109858

ALGEBRAIC GEOMETRY 1

Second-cycle degree in Mathematics
Language: English
Teaching period: second semester
Lecturer: Bruno Chiarellotto
Credits: 8 CFU/ECTS

3

Prerequisites
Basic commutative algebra and basic geometry of the first 3 years in math.

Programme
The aim of the course is to introduce the language of schemes connected with classical algebraic geometry. We will introduce Projective and affine varieties, relation with commutative algebra, Blow ups. Schemes and sheaves. The topological notion translated in this setting: separateness, properness, smoothness. An introductions to some invariants.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109782

ALGEBRAIC GEOMETRY 2

Second-cycle degree in Mathematics
Language: English
Teaching period: second semester
Lecturer: Matteo Longo, Marco Andrea Garuti
Credits: 6 CFU/ECTS

4

Prerequisites
Galois theory; Commutative algebra. Students are not required to have already taken Algebraic Geometry 1, but it is assumed that are following that course.

Programme
The aim of the course is to give an introduction to the Galois theory of homogeneous linear differential equations. This theory goes back to the 19th century and parallels the Galois theory for algebraic field extensions. It studies the (usually non-algebraic) extensions obtained by adding to a function or power series field a full set of solutions of a differential equation. The notions of splitting field of a polynomial, Galois group and solvability by radicals have their counterpart in the notions of Picard-Vessiot extension, differential Galois group and solvability by quadratures. The differential Galois group of a homogeneous differential equation is a linear algebraic group, carrying both the structure of an algebraic variety and a group law given by algebraic functions.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109783

APPLIED GEOCHEMISTRY

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: first semester
Lecturer: Christine Marie Meyzen
Credits: 6 CFU/ECTS

5

Prerequisites
All students must have a basic knowledge of geochemistry, geology, mineralogy and petrography.

Programme
This course is intended to provide the student with an understanding of the main geochemical interaction processes among the various Earth's geochemical reservoirs (lithosphere, pedosfere, biosphere, hydrosphere and atmosphere) by exploring their impacts on various environmental reservoirs and their induced effects on ecosystems and health of living beings. A special emphasis will be placed on how anthropogenic activities disturb these chemical interactions on Earth. Specifically, we will examine the sources, reactions, transport, effects, and fates of chemical species in air, water, and soil environments, and the effects of technology thereon.
Environmental issues that will be discussed include climate change, air and water pollution. Analytical methods and their limits - Geochemical modeling - Biogeochemical cycles - Composition and quality of natural waters and their main classification schemes - Chemical and mineralogical transformations during weathering processes - Chemistry and properties of soils - Chemical composition of the atmosphere - Chemical elements as proxies of the pollution of surface water bodies and groundwater, soils and atmosphere (ozone, greenhouse effect, water pollution by heavy metals) - Mapping and geochemical sampling.
At the end of the course, students will be able to:
- Understand the natural geochemical cycles of elements at the surface of the Earth, as well as the

effects of human activities upon these cycles.
- Understand the processes involved in the distribution and transport of chemical substances between the atmospheric, continental and marine environments.
- Reflect on the interactions among chemical, geological, physical and biological environmental processes.
- Interpret environmental geochemical data sets.

Examination
Written and oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1109906

APPLIED PETROGRAPHY

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: first semester
Lecturer: Claudio Mazzoli
Credits: 6 CFU/ECTS

6

Programme
This course examines in depth application aspects of petrography with reference to the following arguments: physical-chemical properties and decay of natural ornamental and dimension stones; traditional ceramic materials; hydraulic and non-hydraulic binders; applications to archaeometry.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1096159

ASTRONOMICAL SPECTROSCOPY

Second-cycle degree in Astronomy
Language: English
Teaching period: second semester
Lecturer: Piero Rafanelli
Credits: 6 CFU/ECTS

7

Prerequisites
Basic Physics I and II, Calculus I and II, Atomic Physics, Astrophysics I - II.

Programme
Radiation in the interstellar gas: definition of radiative terms; transfer equation; local thermodynamic equilibrium; equivalent thermodynamic equilibrium. Emission and absorption lines in the interstellar environment: emission and absorption coefficients; statistic equilibrium; collisional processes and kinetic temperature; excitation in interstellar conditions; forbidden lines; recombination lines; intensity of lines as a function of density and temperature. Continuum emission and absorption processes: free-free transitions; intensity of the thermal radio continuum; bound-free and free-bound transitions; synchrotron radiation. Ionization: ionization equilibrium; ionization of hydrogen; HII regions; ionization of helium; dust extinction; HI regions; ionization of the heaviest elements. Formation and dissociation of interstellar molecules: molecular hydrogen; CO, OH, H2O in diffuse nebulae; molecules in dense nebulae. Thermal equilibrium and kinetic temperature of gas: Equation of thermal equilibrium; heating and cooling processes of gas; thermal equilibrium of HII regions; thermal state of HI regions.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1173/2010/002PD/1109411

ASTROPHYSICS 2 (also offered as Theoretical Astrophysics in the Second-cycle degree in Astronomy)

First-cycle degree in Astronomy
Language: English
Teaching period: second semester
Lecturer: Paola Marigo
Credits: 6 CFU/ECTS

8

Prerequisites
Elements of plane trigonometry, derivatives, integrals, basic knowledge of physics relating to previous courses.
Preparatory courses: Astronomy I (two years) and Astronomy II (model A, third year).

Programme
1. Introduction and overview.
Observational constraints, the H-R diagram, mass-luminosity and mass-radius relations, stellar populations and abundances.
2. Hydrostatics, energetics and timescales.
Derivation of three of the structure equations (mass, momentum and energy conservation). Hydrostatic and thermal equilibrium. Derivation of the virial theorem and its consequences for stellar evolution. Derivation of the characteristic timescales of stellar evolution.
3. Equation of state (EoS).
Local Thermodynamical equilibrium. General derivation of n, U, P from statistical mechanics. Limiting cases: ideal gas, degeneracy. Mixture of gas and radiation. Adiabatic processes. Ionization (Saha equation, consequences for thermodynamic properties).
4. Energy transport in stellar interiors.
The 4th equation of stellar structure: the energy transport equation.
Diffusion approximation for radiation transport. The radiative temperature gradient . Opacity. Eddington luminosity. Convection: Derivation of stability criteria (Schwarzschild, Ledoux) .Convective energy transport: order-of-magnitude derivation. Mixing-length theory.
5.Nuclear reactions.
Nuclear energy generation (binding energy). Derivation of thermonuclear reaction rates (cross sections, tunnel effect, Gamow peak). Temperature dependence of reaction rates. Nuclear burning cycles: H-burning by pp-chain and CNO-cycle. He burning by 3-alpha and alpha+C reactions. Advanced burning reactions.
6. Stellar evolution equations.
Overview, time/space derivatives, limiting cases. Boundary conditions and their effect on stellar structure. How to obtain solutions.
7. Simple stellar models.
Polytrophic models. Homology relations: principles, derivations, application to contraction and the main sequence. Stability of stars: derivation of simplified criteria for dynamical and secular stability.
8. Schematic evolution from the virial theorem (VT).
Evolution of the stellar center combining the VT and the EoS: evolution tracks in terms of (P,rho) and (T,rho). Evolution towards degeneracy or not. The Chandrasekhar mass, low-mass vs massive stars . Critical ignition masses, brown dwarfs, nuclear burning cycles.
9. Detailed evolution: towards and on the main sequence.
Simple derivation of Hayashi line, pre-MS evolution tracks properties of the ZAMS: M-L and M-R relations, occurrence of convection zones evolution across the MS band: structural changes, low-mass vs high-mass, effects of overshooting.
10. Post-MS evolution.
The Chandrasekhar limit, the mirror principle. H-shell burning: Hertzsprung-gap, red giant branch, first dredge-up. He-burning: horizontal branch, loops, Cepheids. RGB mass loss.
11. Late evolution of low- and intermediate-mass stars.
The Asymptotic Giant Branch: thermal pulses, 2nd/3rd dredge-up, mass loss, nucleo-synthesis. White dwarfs: structure, non-ideal effects, derivation of simple cooling theory.
12. Pre-SN evolution of massive stars.
Importance of mass loss across the HRD (O stars, RSG, LBV and WR stars). Modern evolution tracks. Advanced evolution of the core: nuclear burning cycles and neutrino losses, acceleration of core evolution. Pre-SN structure

13. Explosions and remnants of massive stars. Evolution of the core towards collapse: Fe-disintegration, electron captures, role of neutrinos supernovae. Observed properties and relation to massive star evolution. Limiting masses for neutron star and black hole formation, dependence on mass loss and metallicity.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1160/2008/000ZZ/1109382

BASIN ANALYSIS

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: second semester
Lecturer: Massimiliano Zattin
Credits: 6 CFU/ECTS

9

Prerequisites
Basic knowledge of some courses of the first semester (Applied geophysics, Micropaleontology, Applied geochemistry).

Programme
The course is intended to cover modern concepts of tectonics and analysis of sedimentary basins through the illustration of geodynamic systems involving basin development. After a first view of classification schemes, basics and mechanics of basins formation will be therefore described in their plate tectonic environment and according to the geodynamic regime: rifts and passive continental margins, orogenic wedges and lithospheric buckling, strike-slip settings. The different topics will be illustrated through many examples from around the world. The course will include a review of key analytical techniques for a quantitative approach with a focus on burial history analysis.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1109905

BIOCHEMISTRY

Second-cycle degree in Molecular Biology
Language: English
Teaching period: first semester
Lecturer: Ildiko Szabò
Credits: 8 CFU/ECTS

10

Prerequisites
Basic level of biochemistry, cellular biology and physiology.

Programme
Import of proteins into organelles (mitochondria, chloroplasts and peroxisomes): targeting mechanisms, import machineries, energy requirements, dual targeting, retrograde signaling between nucleus and bio-energetic organelles. Protein degradation by ubiquitin-proteasoma pathway: mechanisms of ubiquitination, function of proteasomes, physiological significance of ubiquitin-mediated protein degradation, cell cycle and apoptosis. Membrane proteins: characteristics of membrane proteins, topology and its determination; state of the art methods for study of membrane proteins, structure-function relationship of an ion channel as membrane protein.
Exercise in class room: Journal club, virtual research program
Laboratory exercise: purification and biochemical characterization of a membrane protein (preparation of thylakoids, membrane solubilization, alkaline extraction, treatment with protease, SDS-PAGE, Western blot).

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1175/2008/000ZZ/1109364

BIODIVERSITY AND BEHAVIOR

Second-cycle degree in Marine Biology
Language: English
Teaching period: second semester
Lecturer: Matteo Griggio
Credits: 8 CFU/ECTS

11

Prerequisites
To successfully follow this course, it is desirable that the student has taken courses in ecology, and in particular in marine ecology, at different levels (population, community).

Programme
Biodiversity: the concept of biodiversity, the diversity of organisms and the ecological systems in which they live. The key role of evolution in shaping biodiversity. Ecological pressures on the morphology and behaviour of marine species. Morphological and behavioural adaptations to different marine habitats (pelagic, benthic, abyssal, intertidal). Biodiversity as the web of complex interrelationships between organisms, the contribution of the study of animal behaviour to understanding the concept of biodiversity. The study of reproductive behaviour, parental care, mimicry and social life, using the most modern concepts of behavioural ecology. Anthropic pressures on marine species and marine habitats. Anthropic impacts on marine species behaviour.

Examination
Written.

More Information
http://en.didattica.unipd.it/offerta/2014/SC/IF0360/2013/000ZZ/1095955

BIOINFORMATICS

Second-cycle degree in Computer Science
Language: English
Teaching period: first semester
Lecturer: Giorgio Valle
Credits: 6 CFU/ECTS

12

Prerequisites
There are no particular prerequisites other than what it is expected from a master student in informatics. However, a basic knowledge of genetics and molecular biology will help in the understanding of the biological motivations of bioinformatics.

Programme
The course is divided in three main parts. The first part is an extensive introduction on Biology presented as a scientific field centered on Information. The mechanisms that facilitate the transmission and evolution of biological information is be used to introduce some biological issues that require computational approaches. The second part of the course describes the main algorithms used for the alignment of biological sequences, including those designed for "next generation sequencing". The algorithms used for de novo genomic assembly are also described. Finally, the third part of the course covers several aspects of bioinformatics related to functional genomics, such as the analysis of transcription, gene prediction and annotation, the search of patterns and motifs and the prediction of protein structures. The role of Bioinformatics in individual genomic analysis and personalized medicine is also discussed.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1176/2014/000ZZ/1109586

BIOPOLYMERS

Second-cycle degree in Industrial Chemistry
Language: English
Teaching period: first semester
Lecturer: Stefano Mammi
Credits: 6 CFU/ECTS

13

Prerequisites
None.

Programme
The course describes in general terms the study of structural properties of biological macromolecules, such as polypeptides and proteins, polynucleotides, and polysaccharides. The course is divided into three parts: in the first one, the structural properties of natural and synthetic biopolymers are described and discussed while the second describes some industrial applications of artificial and natural biopolymers and biocompatible and/or biodegradable polymers; finally, the main methods for the study of conformations, interactions and conformational transitions of biopolymers are considered in the third part.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1170/2013/000ZZ/1096672

CELESTIAL MECHANICS

Second-cycle degree in Astronomy
Language: English
Teaching period: second semester
Lecturer: Stefano Casotto
Credits: 6 CFU/ECTS

14

Programme
1. The equations of motion of a system of N bodies - Symmetries and first integrals - Reference frames
2. The Two-Body Problem - The conic section solutions and their representations - Regularization and formulation in universal variables
3. Computation of an ephemeris
4. Preliminary orbit determination - The method of Laplace - The method of Gauss.
5. Relative Keplerian motion - Rendez-vous - Orbital maneuvers
6. Lambert's theorem - Lambert targetting
7. The Three-Body Problem - Homographic solutions
8. The Circular Restricted Three-Body Problem - The Jacobi integral - Zero velocity surfaces - Periodic orbits
9. Navigation in the Solar System - The method of patched conics

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1173/2010/001PD/1109406

CHEMISTRY OF ORGANIC MATERIALS

Second-cycle degree in Chemistry
Language: English
Teaching period: second semester
Lecturer: Enzo Menna
Credits: 6 CFU/ECTS

15

Prerequisites
General Organic Chemistry.

Programme
The course program covers main application fields for advanced organic materials. Each application will be discussed with regard to: theoretical bases required to understand how the material works, different chemical classes, different kind of structures, synthesis and characterization, structure-property relationships, device fabrication techniques, examples of application. The following topics will be considered: Fullerenes, nanotubes and other carbon nanostructures, Organic photovoltaic devices, Organic electroluminescent materials (OLED), Self assembled layers of organic molecules, Molecules for non-linear optics, Biomimetic materials, Structural organic materials (main classes of plastic and engineering polymers, their application, synthesis and properties).

Examination
Oral.

More Information
http://en.didattica.unipd.it/offerta/2014/SC/SC1169/2013/000ZZ/1116186

COMMUTATIVE ALGEBRA

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Marco Andrea Garuti
Credits: 8 CFU/ECTS

16

Prerequisites
Basic notions of algebra (rings, ideals, fields, quotients, etc.), as acquired in the class "Algebra 1".

Programme
Commutative rings with identity, ideals, homomorphisms, quotient rings. Fields, integral domains, zero divisors, nilpotent elements. Prime ideals and maximal ideals. Spec(A). Max(A). Local rings and their characterization. Operations on ideals (sum, intersection, product). Extension and contraction of ideals w.r.t. homomorphisms. Quotient ideal, annihilator of an ideal, radical of an ideal, nilradical of a ring, Jacobson radical of a ring, reduced rings, Jacobson rings. The Zariski topology on Spec(A). The affine spectrum of A/I as closed subset of Spec(A). Direct product of rings. Connected and irreducible spectra. Modules, submodules and their operations (sums, intersection). Product of an ideal and a submodule. Annihilator of a module. Faithful modules. Direct sums and direct products of modules. Finitely generated modules, free modules and free basis. Nakayama's lemma. Tensor product and its properties. Extension and restriction of scalars for modules. Algebras over a ring and their tensor product. Exact sequences of modules, ker-coker sequence. Right exactness of the tensor product. Flat modules (5 equivalent definitions). Chain conditions on modules. Artinian and Noetherian modules. Chain conditions on rings. Noetherian rings. Hilbert's basis theorem. Primary decomposition. Rings of fractions, localization of a ring at a prime ideal. Localization of modules. Exactness of localization. Flatness of a localization of A over A. Examples of local properties of rings and modules. Characterization of the spectrum of a localized ring, in particular the homeomorphism of D(f) with the localization of A at f. Integral elements, integral extension of rings, integral closure of a ring A in a ring B. Properties of integral extensions. Integrally closed rings. Algebraically independent elements. Noether's Normalization Lemma and its corollaries: Hilbert's Nullstellensatz theorem in its various forms and its geometrical meaning. Valuation rings. Artin rings. Characterization of Artin rings Discrete valuation rings, charactrization of DVR. Dedekind domains and their characterization.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109777

COMPLEX ANALYSIS

Second-cycle degree in Mathematics
Language: English
Teaching period: second semester
Lecturer: Andrea D'Agnolo
Credits: 6 CFU/ECTS

17

Prerequisites
undergraduate courses in Calculus and Geometry elementary notions on complex functions of one complex variable. In particular:
Cauchy-Riemann identities and complex differentiation; holomorphic functions. Line integrals of complex functions and their homotopy invariance. Logarithm of a path and winding number. Cauchy formula for a circle. Analiticity of holomorphic functions. Zero-set of a holomorphic function; the identity theorem. Open mapping theorem. Laurent series and isolated singularities. Residue theorem, and its use for the computation of integrals. Argument principle.

Programme
The argument principle and applications. The Schwarz reflection principle. Conformal maps and the Riemann Mapping theorem. Runge's theory and applications. Mittag-Leffler's theorem and elliptic functions. The Weierstrass factorization theorem. Principal ideals of holomorphic functions. Some special functions (Gamma, Zeta). The Prime Number theorem

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109778

COMPUTATIONAL FINANCE

Second-cycle degree in Statistical Sciences
Language: English
Teaching period: first semester
Lecturer: Massimiliano Caporin
Credits: 9 CFU/ECTS

18

Prerequisites
Elements of Economics and Mathematics of Financial Markets, elements of Statistics and Econometrics. Knowledge of the mean-variance approach of Markowitz, of the CAPM and APT models, and of the pricing of derivatives with binomial trees and with the Black and Scholes model.

Programme
Part 1: The formalization of computational problems into a statistical package
- Introduction to the software; data management; basic tools for descriptive and graphical analyses;
- Basic data manipulation tools; using already implemented functions;
- Basic programming and how to write a batch file for execution;
- Introduction to simulation methods: simulations from a given density; resampling/bootstrap from historical series; model-based bootstrap;
- Further elements will be introduced during the course, when needed.

Part 2: Asset Allocation
- The classic approach, Markowitz's world: the efficient frontier with and without the risk-free asset and its empirical evaluation;
- Markowitz in realistic applications: no short selling constraints, linear constraints, turnover constraints, inequality constraints, probabilistic constraints, cardinality constraints; empirical examples; the need of non-standard optimization approaches (mixed quadratic-integer programming and genetic algorithms);
- The use of Markowitz in asset allocation programs and for strategic asset allocation;

- Beyond Markowitz: from mean-variance, to mean-VaR; the optimization of alternative criterion functions; higher order portfolio allocation, is it worth? the modern approach of Risk Budgeting, implementation and examples; the information content of extreme market moves in the computation of the mean-variance matrix (the Chow-Kritzmann approach); is the historic efficient frontier fully reliable/the unique solution? Michaud's simulation-based approach to the computation (and rebalancing) of efficient portfolios;
- Investing for the long run: returns predictability and mean reversion; identification of optimal portfolios and simulation of wealth paths;

Part 3: Risk Management and performance evaluation
- The construction of simulated track records in allocation programs; methods and indicators for portfolio monitoring and performance evaluation; portfolio turnover and portfolios costs;
- Indicators for the evaluation of portfolio risk (market risk, credit risk, systemic risk); some notes on operational risk;
- The VaR and ES as methods for the evaluation of market risk; computing VaR and ES for one single position and at the portfolio level; historical approaches, model-based methods, simulation approaches, the use of copula functions;
- Portfolio exposure to risk-factors: single-index and multifactor models; conditional factor models; models for market timing; VaR with risk-factors;

Part 4: Pricing of derivatives and interest rates
- Pricing in Black & Scholes world; replicating Black & Scholes by simulation; pricing of selected exotic options;
- Pricing by simulation and time-series model-based methods;
- Estimation of the interest rate zero curve by bootstrapping.

The program might be subject to changes depending on a number of elements including: the interest of the students and their ability to solve computational problems with the statistical sowftare; the occurrence of particular events in the financial markets. Changes to the program content will affect the list of tasks included in the team work.
The program above refers to both the main module and the second module of the course.

For students in the degree of Statistics, the topics covered in the main module will be detailed at the befinning of the course. The second module will deal with the following topics:
- Introduction to financial instruments and markets;
- Investment choices under uncertainty and the approach of Markowitz;
- Market equilibrium, CAPM and APT, and market efficiency;
- Derivative pricing in discrete and continuous time.

Examination
Group homework.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2014/000ZZ/1111478

COMPUTATIONAL METHODS IN MATERIALS SCIENCE

Second-cycle degree in Materials Science
Language: English
Teaching period: second semester
Lecturer: Francesco Ancillotto/ Alberta Ferrarini
Credits: 6 CFU/ECTS

19

Prerequisites
Quantum and solid state physics, physical chemistry.

Programme
Basic concepts of thermodynamics and classical statistical mechanics.Classical Molecular Dynamics simulations; numerical integration of Newton equations.Monte Carlo method; Metropolis algorithm.Simulations in various statistical ensembles.Common features of simulations methods: initial and boundary conditions; calculation of inter-particle interactions.Calculation of thermodynamic and transport properties.Intermolecular interactions: force-fields; atomistic and coarse grained models.Variational methods for the solution of the Schrodinger equation.Hartree and Hartree-Fock theory. Elements of Density Functional Theory (DFT).'First principles' simulations. The different computational methods will be discussed in relation their application to topics of interest for material science (crystals, surfaces, soft matter, nanostructured materials).In the computer exercises, students will carry out simple simulations, using software packages that are currently employed in materials science, and they will learn how to interpret and present the results of simulations.

Examination
Oral examination in which the students will discuss a written report, on the results of simple numerical simulations

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1174/2013/000ZZ/1116660

COMPUTER SECURITY

Second-cycle degree in Computer Science
Language: English
Teaching period: second semester
Lecturer: Mauro Conti
Credits: 6 CFU/ECTS

20

Prerequisites
Basic knowledge of distributed systems, cryptography and network security.

Programme
- COMPUTER SECURITY PRINCIPLES AND PRACTICE. Computer security technology and principles. Software security and trusted systems. Management issues. Cryptographic Algorithms. Network Security.
- ADVANCED TOPICS based on a selection of scientific papers that either have had a strong impact on security today, or explore novel ideas that may be important in the future.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1176/2014/000ZZ/1109633

COSMOLOGY

Second-cycle degree in Astronomy
Language: English
Teaching period: second semester
Lecturer: Alberto Franceschini
Credits: 6 CFU/ECTS

21

Programme

1. The Large Scale Structure of the Universe. Local properties.
General and structural properties of the universe. Large scale distribution of galaxies. Angular and spatial
correlation functions. Higher order correlations. Limber relation.
Power-spectrum of the cosmic structures. Relationship of the power-spectrum and ξ(r). Observational data on the large scale structure. The initial power-spectrum of the perturbations.
3D mapping of galaxies, clusters, AGNs. Counts-in-cells. Outline of fractal and topological analyses of the
universe.
2. The Homogeneous and Isotropic Universe. Hubble law. The Cosmological Principle. Isotropic curved spaces. The Robertson-Walker metric. Geometrical properties of the space-time. Cosmic dynamics, the newtonian and general-relativistic
approach. Cosmological models and parameters. Fundamental observables. The redshift. Luminosity and
angular diameter distances. Time-redshift relations. Hubble diagrams.
Generalized dynamical equations. The cosmological constant. Observational evidences
3. Deviations from homogeneity and isotropy. Gravitational lensing
Point-like lenses and isothermal spherical distributions. Lens potentials. Einstein radius. Lensing cross-sections. Lensing effects on time lags. Caustics. Observations of the gravitational lensing and cosmological applications. Estimate of the total galaxy cluster mass. Estimates of H0 . Effects of a cosmological constant L in the lensing statistics.
4. Perturbations in an expanding universe. Peculiar motions of galaxies and structures. Deviations from the Hubble flow, peculiar velocities in the cosmos. Observations of peculiar velocity Fields. Origin of the large scale motions. Evolution of perturbations in the cosmic fluid in the linear regime. Hubble drag. Relationship of perturbations and the velocity fields.
Constraints on the cosmological parameters from the large scale motions.
5. Brief thermal history of the Universe
The matter and radiation content of the Universe. Energy densities. Radiation-dominated universes. The epoch of recombination and equivalence. Time-scales of cosmic evolution.
Cosmic entropy per barion.
Primordial nucleo-synthesis.
6. The Cosmic Microwave Background
Discovery of the CMB. Observations from ground and from space. COBE & WMAP.
Origin of the CMB.
Spatial properties, isotropy of the CMB.
Statistical description of the angular structure.
Origin of the CMB angular fluctuations.
Physical processes in operation on the large scales. Fluctuations on intermediate angular scales. Contributions of sources to the anisotropies on small scales.
Constraints of CMB observations on the cosmological parameters.
The CMB spectrum. Spectral distortions.
The Sunyaev-Zeldovich effect. Observational limits on the spectral distortions and their implications.
7. The Primordial Universe, Big Bang, phase transitions, cosmological inflation
The problem of the cosmological horizons.
Propagation of the information and visibility of the universe.
Big Bang singularity. Planck time.
Overview of the standard model of elementary particles. Fundamental interactions.
Cosmological phase transitions and their

epochs.
Open questions about the standard Big Bang model. The horizon problem. The flatness problem. Cosmological inflation and solutions to the problems.
The Anthropic Principle.
8. The Post-Recombination Universe
Cosmological evolution of galaxies and active galactic nuclei.
Evolutionary history of star formation and production of heavy elements. Contributions to the background radiations.
Intergalactic diffuse gas. Absorption-lines in quasar spectra, Lyman-alpha clouds. The missing baryon problem.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1173/2010/002PD/1109413

CRYPTOGRAPHY

Second-cycle degree in Computer Science
Language: English
Teaching period: first semester
Lecturer: Alessandro Languasco
Credits: 6 CFU/ECTS

22

Prerequisites
The topics of the following courses: Algebra, Calculus and Algorithms (especially for computational complexities estimates).

Programme
First Part: Basic theoretical facts: Modular arithmetic. Prime numbers. Little Fermat theorem. Chinese remainder theorem. Finite fields: order of an element and primitive roots. Pseudoprimality tests. Agrawal-Kayal-Saxena's test. RSA method: first description, attacks. Rabin's method and its connection with the integer factorization. Discrete logarithm methods. How to compute the discrete log in a finite field. Elementary factorization methods. Some remarks on Pomerance's quadratic sieve.
Second Part: Protocols and algorithms. Fundamental crypto algorithms. Symmetric methods (historical ones, DES, AES) . Asymmetric methods. Attacks. Digital signature. Pseudorandom generators (remarks). Key exchange, Key exchange in three steps, secret splitting, secret sharing, secret broadcasting, timestamping. Signatures with RSA and discrete log.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109780

DATA ANALYSIS

Second-cycle degree in Statistical Sciences
Language: English
Teaching period: first semester
Lecturer: Monica Chiogna
Credits: 9 CFU/ECTS

23

Prerequisites
Basic Mathematics (undergraduate level). It would be advantageous to have some background knowledge of elementary Probability Theory.

Programme
Part 1: Statistical Methods (6ECTS)
- Visualization: plots including histograms, box plots, scatterplots, scatterplot matrices, etc.
- Summary statistics and goodness-of-fit tests. One- and two-sample examples, t and F distributions.
- Concepts of simulation: simple simulation experiments.
- Linear regression, including multiple linear regression. Associated inference problems. Regression diagnostics. Classical approaches to ANOVA. Model selection.
- Logistic regression and Poisson regression.
- Introduction to the design of experiments, observational studies and sampling methods.

Part 2: Applied Multivariate Techniques (3ECTS)
- Dimension reduction
- Classification
- Clustering

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2014/000ZZ/1111774

ELECTROCHEMISTRY

Second-cycle degree in Chemistry
Language: English
Teaching period: first semester
Lecturer: Flavio Maran
Credits: 6 CFU/ECTS

24

Prerequisites
B.Sc. level knowledge of Physical Chemistry, Organic Chemistry, and Analytical Chemistry

Programme
Electrochemistry is described from a detailed description of the equilibrium and transport properties of the phases forming the electrochemical systems. Electrochemical kinetics in terms of electron transfer, mass transport, and associated chemical reactions as the rate determining steps. Main electrochemical methods, such as chronoamperometry, cyclic voltammetry and rotating-disk electrode voltammetry, with emphasis on highlighting the above principles and the type of electrode response to the possible rate-determining regimes. Effect of electrode size. Main scanning electrochemical methods, where tiny conductive probes are used to study and/or modify surfaces.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1169/2013/000ZZ/1098833

ENVIRONMENTAL BIOTECHNOLOGY AND BIOENERGY PRODUCTION

Second-cycle degree in Industrial Biotechnology
Language: English
Teaching period: first semester
Lecturer: Fiorella Lo Schiavo / Tomas Morosinotto
Credits: 8 CFU/ECTS

25

Prerequisites
No specific prerequisites.

Programme
Responses of plants to abiotic stresses: stresses involving water deficit, osmotic stress and its role in tolerance to drought and salinity, impact of water deficit and salinity on transport across plant membranes. Freezing stress. Flooding and oxygen deficit. Oxidative stress. Heat stress. Plant responses to mineral toxicity: Molecular Physiology of mineral nutrient, acquisition, transport and utilization. Aluminium toxicity, heavy metal ion toxicity (Cd2+, Hg2+, Pb2+). Phytoremediation approaches to remove soil/water contaminants.
Bioenergy:
Introduction; current energy sources and the necessity of researching renewable fuels.
The production of bioethanol from ligno-cellulosic biomasses; production of biodiesel from oleaginous crops.
The biotechnological challenges for biofuels production: the optimization of conversion of solar into chemical energy.
Algae as biofuels producers. Evaluation of advantages and disadvantages with respect to plants. Algae cultivation and domestication. Biotechnological approaches for biofuels production in algae. Examples of genetic improvements for biofuels.
Biotechnological approaches for hydrogen production in algae and bacteria.
Examination: Oral, discussion on the subject starting from a recent literature paper.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1731/2010/000ZZ/1099136

ENVIRONMENTAL CHEMISTRY AND GENETIC TOXICOLOGY

Second-cycle degree in Industrial Biotechnology
Language: English
Teaching period: second semester
Lecturer: Paola Venier
Credits: 8 CFU/ECTS

26

Prerequisites:
General and inorganic chemistry, Genetics and basics of life sciences.

Programme
The following contents will be expanded or reduced according to the student skills and interest.
MOD A (Environ. Chemistry). Introduction to the environmental chemistry and chemical cycles. Evaluation of the pollutant distribution and transfer in the atmosphere, hydrosphere and pedosphere. Atmosphere: chemistry and atmospheric pollutants, photochemical smog, role of chemical substances in the ozone layer depletion, inorganic gaseous pollutants, acid rains, greenhouse effect, organic pollutants, particulates. Hydrosphere: nature and chemistry of inorganic and inorganic pollutants, contamination and conditioning/treatment of natural waters. Pedosphere: soil composition and chemistry, with special attention to pesticides, herbicides and heavy metals. Radioactivity: principles of radiation chemistry, ionizing and non-ionizing radiations, dosimetry, exposure effects.
MOD B (Environ. Genetic Toxicology). Historical aspects in toxicology and genetic toxicology. Facts and manifestations of toxicity, with examples referred to metals, persistent organic chemicals, endocrine disruptors, biotoxins. Dose-response and time-response relationships, hormesis. Possible consequences of the exposure to toxic agents at different levels of biological organization, biological targets, biomarkers of exposure and effects. Genotoxic, mutagenic and carcinogenic

agents. Toxicological databases and genetic activity profiles. Spontaneous and induced mutagenesis, dynamic mutations. RNA and protein damage. Effects of non-ionizing and ionizing radiations from the molecular events to late consequences; adaptive response, bystander effects, genetic/epigenetic mechanisms of genomic instability. In vitro and in vivo assays for studying action mechanism and exposure to toxic agents (practical examples and laboratory experiences). Reporter genes and mutation spectra, toxicogenomics (approach and examples).

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1731/2014/000ZZ/1109492

ENVIRONMENTAL IMPACT AND LIFE CYCLE ASSESSMENT

Second-cycle degree in Statistical Sciences
Language: English
Teaching period: second semester
Lecturer: Luca Palmeri
Credits: 6 CFU/ECTS

27

Programme
The course is centered on the environmental impact assessment procedure. In particular the following topics are addressed: legislation (European and national), the administrative practice, the environmental impact study document writing and the tools for the evaluation of impacts. Several other closely related topics are discussed too: the strategic environmental evaluation, incidence evaluation and the integrated pollution prevention and control. After an introduction to the general theory of decision making and of decision support systems, the principal evaluation tools are presented, e.g. multi-criteria analysis, risk analysis and life cycle assessment. Applications to real case studies are foreseen along the entire duration of the course in order to clarify the theoretical subjects presented.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2014/000ZZ/1111755

ENVIRONMENTAL IMPACT ASSESSMENT

Second-cycle degree in Natural Science
Language: English
Teaching period: second semester
Lecturer: Massimo De Marchi
Credits: 6 CFU/ECTS

28

Prerequisites
Ecology and environmental law.

Programme
Objectives
To provide the students with the basic theory and practice for conducting the principal procedures for environmental evaluations
A student who has met the objective of the course will be able:
To know Environmental Impact Assessment (EIA) and Strategic Impact Assessment (SEA) procedures
To know the main legislative and regulatory dispositions at national and international levels (UE, UNECE, USA, Italian Legislation and some regional legislation)
To handle the preparation of the Environmental Impact Statement under EIA procedure and Environmental Report under the SEA procedure
To deal with the impact on biodiversity under Habitat Directive and the assessment of implications
To manage tools for environmental assessment
To manage tools for participation management under environmental evaluation procedures

Program
The role and need for evaluation
Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA): regulations, procedures, case studies, European and International comparisons
Art. 6 of Habitat directive and assessment of implications on Natura 2000 sites: procedures and case studies
Landscape and Visual Impact Assessment: procedures and case studies
Social Impact Assessment and interaction with environmental assessment: key case studies
Ecosystem services approach in environmental assessment
GIS techniques and Multi Criteria Models for environmental assessments
Integrated pollution prevention and control (IPPC)
Accounting methods for environmental good and services: Contingent Evaluation, Cost/Benefits Analysis
The management of participation inside environmental assessment procedures
Voluntary tools: Environmental Managements Systems (EMAS and ISO 14.001) and Environmental Certification of Products (EPD and Ecolabel)

Examination
Working group report plus oral examination.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1178/2014/000ZZ/1109931

ENVIRONMENTAL MINERALOGY

Second-cycle degree in Natural Science
Language: English
Teaching period: second semester
Lecturer: Gilberto Artioli
Credits: 8 CFU/ECTS

29

Programme
Aims: The course will introduce the fundamental concepts of the mineralogy and the petrology of Earth's crust materials, as a base to characterize and interpret natural and anthropogenic processes having environmental implications. The program will encompass several case-studies. Each case will be discussed under the point of view of the analytical and instrumental problems, of the physico-chemical mechanisms, and of the interpretative methodologies of the processes.
Programme:
- Natural solid materials: basic concepts of mineralogy and petrology.
- Natural processes. Introduction on the distribution of the chemical elements on the Earth's crust, on the geological processes, on the geochemical cycles. Processes and fluid-solid interactions at the mineral surfaces. Experimental techniques to study materials surfaces.

Case studies:
- (1) Hazardous minerals in nature and in working places: asbestos, free silica. Environmental monitoring, assessment, mineral quantification, disposal.
- (2) Microporous minerals: clays, zeolites. Crystal structure, crystal chemistry, absorption properties, ionic exchange properties, catalysis. Their use in environmental and industrial applications.
- (3) Mineral dust. Origin, characterization. Implications for the palaeoclimatic and environmental reconstructions of the investigations of mineral dust entrapped in polar ice.
- (4) Metals and the environment. Dispersion and re-mobilization of toxic elements during mineral deposits exploitation. Acid mine drainage. The case of arsenic dispersion: inorganic vs bio-controlled processes. The topics will be shown and discussed with the aid of specific scientific literature.

Teaching aids:
- web notes and material (http://www.geoscienze.unipd.it/studenti/artioli/HTC/index.html)
- volume: D. Vaughan, R.A. Wogelius "Environmental mineralogy" EMU Notes in Mineralogy, Vol. 2, 2000
- issues of the journal "Elements" (http://www.elementsmagazine.org/index.htm)

Examination
The final examination will include an oral colloquium on the course programme and a student's seminar on a specific topic selected among those discussed during the course and integrated by specific readings.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1178/2014/000ZZ/1109933

ETHOLOGY

Second-cycle degree in Evolutionary Biology
Language: English
Teaching period: second semester
Lecturer: Andrea Augusto Pilastro
Credits: 6 CFU/ECTS

30

Prerequisites
Good knowledge in evolutionary biology, ecology, genetics, and zoology (advanced undergraduate course level).

Programme
This course introduces the students to the scientific study of the behavior of animals. Providing a theoretical framework, illustrated with numerous examples, all aspects of animal behavior are discussed. Students will be encouraged to think about the evolutionary origin and adaptive significance of behavior. Main topics will regard the link between animal behavior ecology and evolution, the development and control of behavior: genes environment and neural mechanisms, the evolution of animal signals, adaptive responses to predators, foraging behavior and optimality models, reproductive behavior: male and female tactics, mating systems, parental care, sperm competition and sexual selection, sexual conflict, social behavior, kin selection.

Examination
Written (multiple choice questions, open questions).

More Information
http://en.didattica.unipd.it/offerta/2014/SC/SC1179/2009/000ZZ/1109348

EVOLUTION AND CONSERVATION

Second-cycle degree in Evolutionary Biology
Language: English
Teaching period: first semester
Lecturer: Andrea Pilastro
Credits: 6 CFU/ECTS

31

Prerequisites
Good knowledge in evolutionary biology, ecology, genetics, zoology and botany (advanced undergraduate course level).

Programme
The course will focus on genetic and evolutionary applications to the problems of conservation, while reflecting the diversity of concerns that are relevant to conservation biology. Particular emphasis will be put on themes like measures of phylogenetic diversity and uniqueness, population genetic structure of natural and managed populations including the identification of `evolutionary significant units' and `management units' for conservation, assessment of levels of genetic variation within species and populations, assessments of the effect of sexual selection mate choice and reproductive strategy on population conservation, forensic applications, methods for maximizing genetic diversity during captive breeding programs and re-introduction schemes, effect of anthropogenic factors on evolutionary adaptation to local changes in the environment.

Examination
Evaluation based on written exam. Oral test possible if required by the student (please contact the teacher in advance).

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1179/2009/000ZZ/1100246

FUNCTION THEORY

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Pierdomenico Lamberti
Credits: 8 CFU/ECTS

32

Prerequisites
Measure Theory and Lebesgue integration: basic definitions, classical theorems for passing to the limit under integral sign, Tonelli and Fubini Theorems, basic notions on L^p spaces.

Programme
Theory of Sobolev spaces and applications. Preliminaries on L_p spaces. Weak derivatives. Standard Sobolev spaces and their variants. Lipschitz continuous functions and the Rademacher's Theorem. Approximation theorems. Integral representations. Embedding theorems. Estimates for intermediate derivatives. Compact embeddings. Extension theorems. Trace theorems. Applications: existence of solutions to the Poisson and Dirichlet problems, and to the Helmholtz equation.

Examination
Written + oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/010PD/1109853

FUNCTIONAL ANALYSIS 2

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Massimo Lanza De Cristoforis
Credits: 8 CFU/ECTS

33

Prerequisites
Analysis courses of the first two years and preferably also Real analysis, Mathematical methods, Functional analysis 1.

Programme
Preliminaries in general topology. Vector spaces and their topology. Locally convex topological vector spaces, Frechet spaces. Theory of distributions, tempered distributions and the Fourier transform. Fractional Sobolev Spaces and applications. Elements of interpolation Theory.
Elements of Banach algebras and operator theory.

Examination
Partial tests and final oral exam.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/010PD/1109822

FUNCTIONS OF SEVERAL COMPLEX VARIABLES

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Giuseppe Zampieri
Credits: 6 CFU/ECTS

34

Prerequisites
Basics on functions of one complex variable, differential calculus, differential geometry.

Programme
1.Real and complex differentials
2. Cauchy formula on polydiscs
3. Subharmonic functions
4. Separate analytic functions
5. Analytic functions and convergent power series
6. Levi form and H. Lewy's extension theorem
7. Logarithmic Superharmonicity, Continuity principle, Propagation of holomorphic extendibility
8. Domains of holomorphy end pseudoconvex domains
9. L2 estimates and Neumann problem

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/010PD/1109822

GALAXY DYNAMICS

First-cycle degree in Astrophysics
Language: English
Teaching period: second semester
Lecturer: Giuseppe Galletta
Credits: 6 CFU/ECTS

35

Prerequisites
A basic knowledge of Astrophysical concepts about stars and galaxies from previous courses of Astronomy. Basic elements of Astrophysics, Structure of the Matter, Theoretical physics.

Programme
These lectures are composed by two sections: a theoretical one (3 CFU/ECTS) and a practical one (3 CFU/ECTS)
Theory on galaxy dynamics:
The cosmological framework: birth of modern cosmology.
Cosmological Principles; Einstein's equations (by analogy), Robertson-Walker metric. Friedmann's Equations, Einstein's and de Sitter's solutions.
Crucial phases of the cosmological evolution; Jeans instability, Bonnor reformulation, role of dark matter; spherical collapse of a density perturbation.
Structures on galaxy mass scales in the CDM scenario and their phases before virialization.
The thermodynamic perspective: entropy and information; violent relaxation mechanism in phase-space; Landau-damping and virialization.
Stress tensor and anisotropies of peculiar velocities in the dynamics of stellar systems.
The Fundamental Plane of galaxies and the scale relationships. Theoretical interpretations.
Weak homology. The tensor virial theorem for one and two-component system . The Clausius virial: tidal energy and interaction energy.
Connection with the cosmological scenarios.
The cosmic metaplane.
Observations of galaxy dynamics:
Motions in the milky Way: Velocity ellipsoid near the Sun. Oort formulae.

Mass distribution of stars in galaxies: Surface brightness laws of galaxies. Freeman, De Vaucouleurs and Sersic
laws. Deduction of the main parameters from the observations.
The tridimensional shape of galaxies. Statistical methods. Inclination of a galaxy: principal planes and methods to find inclination and line of the nodes. Polar ring and other reference planes. Twisting of the isophotes.
Rotation curve of a galaxy. Mass estimate with simple models
Observing galaxies at other wavelenghts: HI and CO lines. Observing techniques in our and other galaxies.
Estimate of the gas mass inside a galaxy by means of HI, CO and IR observations.

Examination
Oral exam or, if requested by the most part of the students, written exam (five questions with open-length answer).

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1173/2010/002PD/1109414

GENETIC DISEASES AND MODEL SYSTEMS

Second-cycle degree in Molecular Biology
Language: English
Teaching period: first semester
Lecturer: Mauro Agostino Zordan
Credits: 4 CFU/ECTS

Prerequisites
The course consists in a series of specific seminars dealing with the general topic of genetic diseases and the model organisms employed to study the molecular mechanisms involved in the physiopathology of the diseases. Consequently, all of the courses entailed by the Master's degree are considered preparatory to this course.

Programme
The course is organized as a series of one-hour seminars on topics dealing mainly with genetic diseases and the use of model organisms in genetic disease research. Topics typically touch upon molecular aspects of select genetic diseases and on the application of models such as in vitro mammalian cells, yeast, Drosophila, zebrafish and mouse to study the pathogenetic mechanisms of specific genetic defects. Generally the course activity consists in 12 seminars, which are held during an intensive one-week period.

Examination
The final exam will be written and consists in reading a scientific paper dealing with the subject exposed in one of the seminars and, on the basis of the paper's content, writing an abstract, which for the occasion, will have been concealed from the original paper.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1175/2008/000ZZ/1100293

GENOMICS

Second-cycle degree in Molecular Biology
Language: English
Teaching period: second semester
Lecturer: Giorgio Valle
Credits: 9 CFU/ECTS

Prerequisites
The content of the course has been defined keeping in mind the program of the first level degree in Molecular Biology of the University of Padua. In particular it is expected that the students have a good knowledge of Genetics, Molecular Biology and Bioinformatics.

Programme
Presentation of course and practicals
Introduction: Life, Biology, Information, Genomes, Evolution
History of genomics
Next Generation sequencing (NGS)
NGS: data formats for reads
Classical sequence alignment and assembly algorithms
NGS read alignment
Alignment formats: gff, sam and bam
Genome assembly with NGS data
Mate pair libraries and scaffolding
Metagenomics

Part 2
Transcriptome: Northern, EST, Full length, Microarrays
RNAseq
Analysis of RNAseq data
Proteomics
miRNA,
miRNA target prediction; lincRNA
Interactomics, and functional associations
Gene prediction, gene ontology and gene annotation
DNA methylation and methylome analysis
Histone modification and ChIP analysis"

Part 3
Analysis of human mutations and polymorphisms
GWAS
Genome re-sequencing and Exome sequencing
Personalized medicine and related bioinformatics
Genome browser"
Data integration and systems biology
General summary, discussion and conclusions

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1175/2008/000ZZ/1109368

HIGH ENERGY ASTROPHYSICS

Second-cycle degree in Astronomy
Language: English
Teaching period: second semester
Lecturer: Piero Benvenuti
Credits: 6 CFU/ECTS

38

Programme
The course is aimed at providing the student with a basic knowledge of the physics of plasma with particular attention to the astrophysical plasmas.

Content
Definition of plasma – Plasmas in astrophysics – Observational data – Different theoretical approaches.
Single particle motion – Trapped particles – Conservation relations.
Recalls of dynamics of fluids – Magnetohydrodynamics (MHD).
Waves in plasma fluids – Non linear steepening and shocks – Instabilities.
Collisions – Collisionless plasmas
Cosmic Rays – Fermi acceleration – Shock acceleration
Astrophysical dynamos
Magnetic reconnection
MHD flows in compact astrophysical objects

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1173/2010/001PD/1095175

HUMAN PHYSIOLOGY

Second-cycle degree in Sanitary Biology
Language: English
Teaching period: first semester
Lecturer: Luigi Bubacco
Credits: 9 CFU/ECTS

39

Prerequisites
Biochemistry and General Physiology.

Programme
The Central Nervous System (8 hours)
Neurons: Cellular and Network organization and Properties,
Efferent Division: (10 hours) Autonomic and Somatic Motor Control. Sensory Physiology.
Muscles physiology (8 hours) Control of Body Movement
Cardiovascular Physiology (10 hours) Blood Flow and the Control of Blood Pressure and functional properties of Blood
Respiratory Physiology (8 hours) Mechanics of Breathing. Gas Exchange and Transport
The Kidneys (8 hours) Fluid and Electrolyte Balance
Digestion (8 hours) Energy Balance and Metabolism.
Endocrine Control of Growth and Metabolism (8 hours)
Reproduction and Development (8 hours)

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1177/2008/000ZZ/1111257

IMMUNOLOGICAL BIOTECHNOLOGY

Second-cycle degree in Industrial Biotechnology
Language: English
Teaching period: first semester
Lecturer: Emanuele Papini / Regina Tavano
Credits: 8 CFU/ECTS

40

Prerequisites
The student must have a good preparation in general Immunolgy.

Programme
Aim: understanding vaccinology in its basic medical terms, having a view on the microbiological, molecular biology and chemical approach to design vaccine nowadays. To understand adjuvancy: empirically and rational design and its connections with nanomedicine. Content of the course: Classic Vaccinology; Main problems in the development of a vaccine; production of recombinant vaccines; Microbial, animal and vegetal models for vaccine production - Reverse Vaccinology: genome based antigen individuation (in silico). Production, quality control; Main vaccines in the paediatric prevention in Italy; Adjuvants - Mucosal adjuvant- micro-nanosized new generation adjuvants. The use of dendritic cells in therapy: perspectives.
Practical part: Evaluation in vitro of adjuvancy in human dendritic cells. Isolation of monocytes from blood, their differentiation into Dendritic Cells (DCs). Stimulation of DCs with various adjuvants and analysis of cell activation by Elisa (TNF) and flow cytometry (CD86, CD11), RT-PCR (TNF gene transcription). Autologous/heterologous T lymphocytes proliferation and characterization of their immunological competence by FACS in vaccine design.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1731/2010/000ZZ/1099055

INORGANIC CHEMISTRY FOR ADVANCED TECHNOLOGY

First-cycle degree in Chemistry
Language: English
Teaching period: Second Semester
Lecturer: Vito Di Noto
Credits: 6 CFU/ECTS

41

Prerequisites
Mathematics, Physics, Principles of Chimical and Inorganic Chemistry.

Programme
Part 1: Statistical Methods (6ECTS)
- Visualization: plots including histograms, box plots, scatterplots, scatterplot matrices, etc.
- Summary statistics and goodness-of-fit tests. One- and two-sample examples, t and F distributions.
- Concepts of simulation: simple simulation experiments.
- Linear regression, including multiple linear regression. Associated inference problems. Regression diagnostics. Classical approaches to ANOVA. Model selection.
- Logistic regression and Poisson regression.
- Introduction to the design of experiments, observational studies and sampling methods.

Part 2: Applied Multivariate Techniques (3ECTS)
- Dimension reduction
- Classification
- Clustering

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1156/2008/000ZZ/1110651

INTRODUCTION TO GROUP THEORY

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Andrea Lucchini
Credits: 8 CFU/ECTS

42

Prerequisites
Basic knowledge in general algebra.

Programme
General introduction to group theory: actions of groups, solvable and nilpotent groups, finitely presented groups. A short history of the classification of finite simple groups. Topological groups. Profinite groups (characterizations, profinite completion, countable based profinite groups, arithmetical properties, subgroups of finite index in profinite groups, Galois groups of infinite dimensional extension). Probabilistic methods in group theory.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109785

INTRODUCTION TO QUANTUM ELECTRODYNAMICS

Second-cycle degree in Physics
Language: English
Teaching period: second semester
Lecturer: Pierpaolo Mastrolia
Credits: 6 CFU/ECTS

43

Programme
The main goal of the course is to offer a basic introduction to relativistic quantum field theory, for graduate students with interest in theoretical and experimental high energy particle physics. Langrangian and Hamiltonian description for classical fields will be shortly reviewed, focusing in particular on the relation between symmetry properties of the action and conservation laws.
The quantization for free spin 0, spin 1/2 and spin 1 fields (in the covariant approach) is introduced, through the so called "canonical quantization" procedure.
The case of interacting fields is discussed by the introduction of the scattering matrix formalism. With the aid of Feynman graphs the most relevant QED processes at the lowest order are calculated.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1171/2014/001PD/1109543

INTRODUCTION TO RING THEORY

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Alberto Facchini
Credits: 8 CFU/ECTS

44

Prerequisites
Courses of "Algebra 1" and "Algebra 2". That is, standard undergraduate Algebra.

Programme
Rings. Categories, functors. Modules and their homomorphisms, bimodules, submodules and quotients. Natural transformations. Sets of generators, maximal submodules, free modules and IBN rings, exact sequences, projective modules, tensor product of modules, projective modules over Z. Subcategories. Simple modules, semisimple modules, noetherian modules, artinian modules, modules of finite composition length. Semisimple artinian rings, artinian rings, the Jacobson radical, group representations, local rings, injective modules, projective covers, injective envelopes.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109784

LARGE-SCALE CELL CULTURES AND BIOMOLECULES PRODUCTION

Second-cycle degree in Industrial Biotechnology
Language: English
Teaching period: second semester
Lecturer: Chiara Rampazzo
Credits: 8 CFU/ECTS

45

Prerequisites
Students are expected to have knowledge and competence of cellular and molecular biology and of biochemistry to be able to understand the fundamental aspects of mammalian large scale cell culture in upstream and downstream processes.

Programme
Overview of the biopharmaceutical industry. Upstream and downstream processes. GMP/GLP regulatory requirements for processing biopharmaceuticals. Lab/pilot scale process to implement full manufacturing scale. Consistency and robustness in a fermentation process. Large scale mammalian cell culture. Cell line engineering techniques and common host cell lines used. Bioreactor operation mode: batch, fed batch, continuous and perfusion culture. Selection of bioreactor type (spinner flask, stirred tank). Attachment systems for cell cultivation in adhesion (plates, roller bottle, and stacked plate system) packed bed bioreactor, microcarriers, fluidized bed bioreactor, hollow fiber and wave bioreactor. Perfusion systems for cell cultivation (hollow fiber, spin filter, acoustic cell separation, alternating tangential flow (ATF) system). Design of cell culture medium without serum and with low content of proteins. Scaffold and matrix in bioreactors. How to calibrate oxygen, pH, nutrients and metabolites, cell density and viability in the bioreactor. Design of large scale cell culture process for mammalian cell culture. How to improve cell viability in a process. Expression of cloned proteins in mammalian cells, e.g. interferon and insulin. Large scale

production of monoclonal antibodies and their use. Vaccine process development in mammalian cells and manufacturing of vaccins. Embryonic and adult stem cell cultures and their application in cell therapy. Biomolecules of pharmaceutical interest. Cytokines: interleukins and interferons. Hormons: insulin and growth hormone. Enzymes: tissue plasminogen activator and DNase. Erithropoietin. Heparin. Monoclonal antibodies: pharmaceutical and therapeutic properties. Monoclonal antibody-based drugs for antitumor, immunosuppressive, antithrombotic, antiviral, antiasthma and antiangiogenic therapies. Antisense oligonucleotides: approved agent and clinical trials. Aptamers. Ribozymes.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1731/2014/000ZZ/1109489

MATERIALS FOR ENERGETICS

Second-cycle degree in Materials Science
Language: English
Teaching period: second semester
Lecturer: Vito di Noto
Credits: 6 CFU/ECTS

Prerequisites
Physics, General and Inorganic Chemistry, Physical Chemistry, Solid State Chemistry, Materials Science.

Programme
The course covers the main families of devices for the electrochemical conversion and storage of energy, including primary and secondary batteries, fuel cells, photovoltaic cells and redox flow batteries. The fundamentals of the electrochemical processes taking place at the electrodes are discussed, with a detailed analysis of the interplay between the thermodynamics, kinetics and electrochemistry of the various phenomena. The main properties of the electrolytes are also studied, with a particular reference to the conductivity and charge transfer mechanism. The materials science of the functional materials is covered in detail, highlighting the main physicochemical features and applicability of the various systems. The course is completed by the discussion of the main families of: (a) fuel cells, including PEMFCs, PAFCs, MCFCs and SOFCs; (b) redox flow batteries, such as conventional and hybrid systems; and (c) photovoltaic cells.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1174/2013/000ZZ/1116658

METAMORPHIC PETROLOGY

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: first semester
Lecturer: Bernardo Cesare
Credits: 6 CFU/ECTS

47

Prerequisites
Basic knowledge of petrography, geochemistry and mineralogy.

Programme
Focusing on the metapelitic system, and through extensive practice at the microscopic laboratory, the course will provide deep insight into the main aspects of metamorphic petrology, such as: metamorphic classification; equilibrium assemblages; metamorphic facies; chemographies and other graphical representations; metamorphic reactions and equilibria; role of fluids in metamorphism, fluid inclusions; geothermobarometry and phase equilibria calculations; metamorphism of pelites; contact metamorphism; crustal anatexis; microstructures of anatectic rocks; melt inclusions in migmatites and granulites.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1096169

MOLECULAR BIOLOGY OF DEVELOPMENT

Second-cycle degree in Molecular Biology
Language: English
Teaching period: second semester
Lecturer: Francesco Argenton
Credits: 8 CFU/ECTS

48

Prerequisites
Students should have already acquired a basic knowledge of eukaryotic cell biology, differentiation, histology and developmental biology.

Programme
Learning of theoretical and practical skills in the field of molecular embryology with emphasis on signaling pathways involved in induction, patterning, determination and differentiation of animals.
- Molecular mechanisms of cleavage, gastrulation and morphogenesis in animal models, Genetic dissection of early development.
- Molecular gradients controlling axis formation in vertebrates and Drosophila.
- Paradigms of molecular developmental genetics.
- Acquisition of skills in the presentation of scientific results; performance of practical molecular embryology experiences and their written reports. Principles of digital imaging applied to embryology.

Examination
The exam will be a combination of different tests such as: 1) slide presentation of an article (Journal Club) graded for clarity, completeness of presentation and ability to raise a discussion 2) report of practical laboratory activity and imaging skills 3) Answer an open question on one issue of the course.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1175/2008/000ZZ/1109366

MOLECULAR ECOLOGY AND DEMOGRAPHY OF MARINE ORGANISMS

Second-cycle degree in Marine Biology
Language: English
Teaching period: first semester
Lecturer: Lorenzo Zane
Credits: 7 CFU/ECTS

49

Prerequisites
Basic knowledge of Population Genetics and Ecology.

Programme
The course will emphasize the potential offered by molecular genetic approaches in the study of populations of marine organisms. The topics covered by the course will provide a link between marine population ecology and molecular ecology. The program will first highlight the traits of marine organisms relevant for population dynamics and for the determination of genetic variability and differentiation, and then will focus on the use of molecular markers for identification of individuals, stock, populations and species. Molecular markers will be presented with a practical approach, including class and laboratory activity and literature analysis, with the aim of evidence the experimental approach currently used in molecular ecological studies, the kind of data produced and the available strategies for data analysis.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/IF0360/2013/000ZZ/1109421

MOLECULAR EVOLUTIONARY GENETICS

Second-cycle degree in Molecular Biology
Language: English
Teaching period: first semester
Lecturer: Antonella Russo
Credits: 6 CFU/ECTS

50

Prerequisites
The basic knowledge deriving from the subjects of the first year of the Second-cycle degree.

Programme
Chromosome organization: chromosome banding, chromosome territories. The concept of synteny. Biology explanations for synteny conservation. Karyotype variations in evolution. Evolutionary breakpoints. Mammalian chromosome evolution and phylogenetic analysis. The distribution of evolutionary breakpoints with respect to genome organization and stability. Copy number variation and disease. Evolution of centromeric sequences. Neocentromeres in evolution and disease. (16 h)
Evolution of sex-chromosome divergence. The molecular mechanisms for dosage compensation of sex-chromosome associated genes: the classical paradigm and new insights. Evolution and significance of genomic imprinting. (16 h)
Gene dosage imbalance and dosage compensation mechanisms: the gene dosage control in aneuploidy, polyploidy, copy number variation syndromes. Non random retention of gene duplicates after whole genome duplication events in evolution. (6 h)
A global critical discussion on the topics of the course and on main perspectives. (2 h)
Critical reading and critical discussion (16 h)

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1175/2008/000ZZ/1100291

MORPHODYNAMICS OF LAGOONS, DELTAS AND ESTUARIES UNDER CLIMATE CHANGE

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: first semester
Lecturer: Andrea D'Alpaos
Credits: 6 CFU/ECTS

51

Prerequisites
None.

Programme
Morphodynamics and biogemorphodynamics. Short introduction to coastal systems and to their morphodynamic evolution in response to changes in physical and biological forcings. Relative sea level and its variations. Tides, waves, currents, and sediment transport processes in shallow water systems. Morphology and evolution of deltas, estuaries and lagoons. The Venice Lagoon: its morphological evolution during the past centuries. Will Venice survive? The fate of the Venice Lagoon. General effects of a rising sea level. Natural and anthropogenic forcings. Effects of a changing climate. Effects on deltas, estuaries, and lagoons.

Examination
Written and/or oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1096171

NANOBIOTECHNOLOGY

Second-cycle degree in Industrial Biotechnology
Language: English
Teaching period: first semester
Lecturer: Fabrizio Mancin / Emanuele Papini
Credits: 8 CFU/ECTS

52

Prerequisites
Basic background in chemistry and organic chemistry acquired in the previous fundamental courses. Basic knowledge about formation and properties of nanoparticles.
Previous attendance of the "Nanosystems" course (I semester) is suggested.

Programme
Physio-structural features of the organism which are relevant in the interaction with nano-particles/structures. Cellular and soluble reactions to nano-materials, toxicological and pharmaceutical aspects. Features of the main present nano-assemblies for bio-applications: lipid nanoparticles, polymeric nanoparticles, silica nanoparticles, gold nanostructures, superparamagnetic nanoparticles. Conjugation strategies. Tissue and cell imaging in vivo, diagnosis. The notion of thera(g)nostic. Drug and gene delivery. Vaccines based on nanoparticles. Nano-structures immune adjuvants. Pathogen detection. Protein detection. DNA structure probing. Tissue engineering. Hyper thermic therapy. Photodynamic therapy based on Nanoparticles. Separation and purification of bio-molecules and cells. Contrast agents in MRI.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1731/2010/000ZZ/1099138

NANOSYSTEMS

Second-cycle degree in Industrial Biotechnology
Language: English
Teaching period: second semester
Lecturer: Flavio Maran / Tommaso Carofiglio
Credits: 8 CFU/ECTS

53

Prerequisites
B.Sc. level knowledge of Physical Chemistry and Organic Chemistry.

Programme
The course is organized into two parts. Part A: The goal is to provide the underlying principles to understand i) the forces that determine the formation, dimension, and shape of nanosystems; ii) the physicochemical properties of nanosystems compared to molecules and bulk systems; iii) the fundamental processes mediated by nanosystems; iv) the main methodologies for the characterization of nanosystems. Part B: The goal is to provide the necessary information to understand i) how to prepare different types of nanosystems (possible synthetic problems, stability issues and related limits of use) using top-down and bottom-up approaches; ii) how these systems behave, on a molecular level, toward recognition of and binding with other species; iii) how to utilize them in the interaction with biological targets.

Examination
Written + oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1731/2014/000ZZ/1109488

NUMBER THEORY 1

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Francesco Baldassarri
Credits: 8 CFU/ECTS

54

Prerequisites
A standard Basic Algebra course; a short course in Galois Theory; Linear Algebra; Notions of Calculus.

Programme
Basic algebra of commutative groups and rings. Factorization of elements and ideals Dedekind domains. Algebraic number fields. Rings of integers. Factorization properties. Finite extensions, decomposition, ramification. Hilbert theory. Quadratic and cyclotomic fields. Quadratic reciprocity law. Gauss sums. Minkowski Theory (finiteness of class number and the unit theorem). Examples of cubic fields.

Examination
3 written partials + final oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109787

NUMBER THEORY 2

Second-cycle degree in Mathematics
Language: English
Teaching period: second semester
Lecturer: tbd
Credits: 6 CFU/ECTS

55

Prerequisites
Basic notions of algebraic number theory and Galois theory.

Programme
Ramification theory of finite Galois extensions of local fields and p-adic representations of the Galois group (references to J.-P. Serre, Corps Locaux/Local Fields).

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109788

NUMERICAL MODELING IN GEOSCIENCES

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: first semester
Lecturer: Manuele Faccenda
Credits: 6 CFU/ECTS

56

Prerequisites
Basic knowledge of some courses of the first semester (Sedimentology, Applied geophysics, Micropaleontology, Applied geochemistry).

Programme
The aim of the course is to make the students deeply understand 1) the physics behind the 3 fundamental equations (conservation of mass, momentum and energy) that describe most of the geological processes, and 2) how to solve them numerically. The numerical strategy used is a mixed Eulerian-Lagrangian method, i.e., finite difference with marker-in-cell technique. In order to close the system of equations to be solved, the petro-physical behavior of rocks will be discussed as a function of their composition and different deformational, pressure, temperature conditions. Through the course, the students will step by step build his thermo-mechanical code that will be tested with a series of benchmarks.

Examination
Oral, together with presentation and discussion of the numerical code.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1096170

OPTICS OF MATERIALS

Second-cycle degree in Materials Science
Language: English
Teaching period: first semester
Lecturer: Moreno Meneghetti
Credits: 6 CFU/ECTS

57

Prerequisites
Basic knowledge of electromagnetic wave propagation and of quantum mechanics.

Programme
Interaction of electromagnetic fields with matter will be described for low and high intensity fields, like those of pulsed lasers, and therefore for the description of linear (absorption and refraction) and non linear (from second order to higher orders effects) properties of matter. Simple models and quantum mechanical approaches will be used for obtaining the optical responses of materials and for obtaining the description of phenomena like Sum Frequency Generation, Difference Frequency Generation, for second order effects, or other third order and higher order effects, like Two Photon Absorption, and dynamics of excited state absorptions. Attention will also be given to the properties of nanostructured materials, like plasmonic properties which induce very interesting effects like SERRS (surface enhanced resonance Raman scattering).

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1174/2013/000ZZ/1095391

ORGANIC FUNCTIONAL MATERIALS

Second-cycle degree in Materials Science
Language: English
Teaching period: first semester
Lecturer: Michele Maggini
Credits: 6 CFU/ECTS

58

Prerequisites
Base Chemistry courses of the 3-years Laurea DegreeConcept of allotrope; reactivity of standard and strained olefins and acetylenes; reactivity of the carboxylic group (acyl halides, esters, amides, nitriles); nucleophilic additions to the unsaturated carbon (addition of organolithium and organomagnesium compounds; aldol reactions , cycloadditions (Diels-Alder, 1,3-dipolar cycloadditions to form pyrrolidines, aziridines, ciclopropanes). Semi-empirical methods for the determination of the minimum energy state of an organic molecular structure, calculation and display of frontier orbitals of organic molecules. Excited states of organic molecules: excited singlet state, triplet excited state, intersystem crossing, singlet oxygen vs molecular oxygen. Fundamentals of absorption spectroscopy, emission, IR, Raman, 1H-and 13C-NMR, mass spectrometry, X-ray diffraction analysis; fundamentals of calorimetry (thermogravimetry). Basic Concepts of inorganic semiconductor physics, operation of a conventional solar cell. I/V characteristics, quantum efficiency of a photovoltaic device, photovoltaic conversion efficiency, open circuit voltage, short-circuit current. Basic concepts of electrochemistry (anode, cathode, reduction, oxidation, architecture of an electrochemical cell). Energy and electron transfer in organic molecules. Concept of band-gap for organic and inorganic semiconductors; direct and indirect methods (optical, electrochemical) for the determination of the band-gap. Principles of operation of LED, OLED, FET, OFET. Main polymerization reactions.

Programme: Carbon nanostructures•Fullerenes functionalization• Functionalization of carbon nanotubes and grapheneSemiconducting polymers•Synthesis of semiconducting homo and copolymers •Bandgap engineering of semiconducting polymers•Molecular structures for OLED emitting white or blue light•polymer solar cell

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1174/2013/000ZZ/1116657

PATHOLOGY AND HISTOPATHOLOGY

Second-cycle degree in Sanitary Biology
Language: English
Teaching period: second semester
Lecturer: Cesare Montecucco
Credits: 9 CFU/ECTS

59

Programme
The course consists in 56 hours of lectures that will describe the major causes of diseases, including physical agents, chemicals, drugs, toxins, viruses, bacteria and fungi. The mechanism of pathogenesis of the diseases they cause in humans will be discussed as well as diseases due to alteration of the immune responses.
The course then will treat briefly the mechanism of defense and the reaction of regeneration and repair. The major diseases of blood circulation from heart failure and ischemia to atherosclerosis will be then described. This will be followed by the major human neuro-degeneration diseases. The last part of the course will deal with the molecular, cellular, histological, genetics, clinical pathogenesis of cancers.
The course is integrated by 32 hours of laboratory with experiences on immunological reactions and histopathology of tissue degeneration, atherosclerosis, inflammation and cancers.

Examination
It will be performed with a written test based on three major questions and integrated by an oral part which builds up on the written part.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1177/2008/000ZZ/1111260

PERSONAL FINANCE

Second-cycle degree in Statistical Science
Language: English
Teaching period: first semester
Lecturer: Guglielmo Weber
Credits: 9 CFU/ECTS

60

Prerequisites
Students should have taken a standard finance course, such as Teoria della Finanza (from the graduate programme in "Scienze Statistiche").

Programme
Personal finance (also known as household finance) asks how households actually invest, and how they should invest. It tackles the issues of participation in financial markets and of portfolio diversification. It further investigates financial investment issues that are particularly relevant for individuals or households: housing and mortgage decisions, consumer credit, and investment in private pensions. The first half of the course will be devoted to the standard model, where individuals maximize expected life-time utility subject to a number of constraints. The second half of the course will instead introduce an alternative approach, known as behavioural finance. Behavioural finance builds upon some descriptive models for decision making under risk recently developed by psychologists, focusing on prospect theory, cumulative prospect theory and on the concepts of loss aversion, probability distortion, and mental accounting. This part of the course will provide a description of market anomalies and inefficiencies, and discuss some psychological biases and limits of real investors that might generate those anomalies. It will then present behavioural models for portfolio selection that can explain these anomalies, also discussing how they can be integrated into the advisory process of banks.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2014/000ZZ/1111479

PETROLEUM GEOLOGY

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: second semester
Lecturer: Massimiliano Zattin
Credits: 6 CFU/ECTS

61

Prerequisites
Basic knowledge of some courses of the first semester (Sedimentology, Applied geophysics, Micropaleontology, Applied geochemistry).

Programme
The course will deliver the fundamentals of petroleum geoscience, from the origin and distribution and properties of petroleum to petroleum-bearing rocks. Course topics will be illustrated through case histories and include: the chemistry of petroleum, the organic matter and its maturation in source rocks, petroleum migration, the seal, geology of reservoirs and trap classification. The course will therefore provide the essential tools for understanding the concepts of petroleum system and petroleum play. Case histories will be used to support the concepts and methods, with special emphasis placed upon problems presented by exploration and including some hints about petroleum economics.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1109915

PHYSICAL CHEMISTRY 4

Second-cycle degree in Chemistry
Language: English
Teaching period: first semester
Lecturer: Flavio Maran / Alberta Ferrarini
Credits: 10 CFU/ECTS

62

Prerequisites
B.Sc. level knowledge of Physical Chemistry and Physics.

Programme
Chemical kinetics in terms of simple and complex reaction schemes, and current theories. Marcus and nonadiabatic electron-transfer theories. Electrochemical kinetics. The students are then involved in real kinetic experiments. Fundamentals and application of statistical thermodynamics. Electric properties of molecules in connection with the dielectric properties of matter. Molecular interactions, in terms of pair interactions and their expressions as a function of molecular quantities, with application to ionic crystals and fluids. Interaction of molecules with electromagnetic fields.

Examination
Written + oral.

More Information
http://en.didattica.unipd.it/offerta/2014/SC/SC1169/2013/000ZZ/1116188

PHYSICAL METHODS IN ORGANIC CHEMISTRY

Second-cycle degree in Chemistry
Language: English,
Teaching period: first semester
Lecturer: Alessandro Bagno
Credits: 6 CFU/ECTS

63

Prerequisites
Good understanding of organic chemistry and basic concepts of NMR spectroscopy and mass spectrometry.

Programme
Study aims: identification of organic molecules through the analysis of NMR and mass spectra. Contents: Pulsed NMR (instrumentation, chemical shift, relaxation, scalar coupling, effects of molecular symmetry, decoupling). Dynamic NMR. C-13 NMR. Nuclear Overhauser effect. Introduction to correlation spectroscopy. Mass spectrometry. Instrumentation: ion sources and ionization processes (EI, CI, ESI, APCI, APPI, MALDI); mass analyzers (quadrupole, linear and tridimensional ion trap, time-of-flight analyzer, magnetic and electromagnetic analyzers, hybrid instruments); detectors. Tandem mass spectrometry (MSn), collision induced dissociation (CID). Hyphenated methods (GC/MS, LC/MSn). Applications.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1169/2013/000ZZ/1098837

PHYSICAL METHODS IN ORGANIC CHEMISTRY

Second-cycle degree in Industrial Chemistry
Language: English
Teaching period: first semester
Lecturer: Alessandro Bagno
Credits: 6 CFU/ECTS

64

Prerequisites
Good understanding of organic chemistry and basic concepts of NMR spectroscopy and mass spectrometry.

Programme
Study aims: identification of organic molecules through the analysis of NMR and mass spectra. Contents: Pulsed NMR (instrumentation, chemical shift, relaxation, scalar coupling, effects of molecular symmetry, decoupling). Dynamic NMR. C-13 NMR. Nuclear Overhauser effect. Introduction to correlation spectroscopy. Mass spectrometry. Instrumentation: ion sources and ionization processes (EI, CI, ESI, APCI, APPI, MALDI); mass analyzers (quadrupole, linear and tridimensional ion trap, time-of-flight analyzer, magnetic and electromagnetic analyzers, hybrid instruments); detectors. Tandem mass spectrometry (MSn), collision induced dissociation (CID). Hyphenated methods (GC/MS, LC/MSn). Applications.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1170/2013/000ZZ/1096676

REPRESENTATION THEORY OF GROUPS

Second-cycle degree in Mathematics
Language: English
Teaching period: second semester
Lecturer: Giovanna Carnovale
Credits: 6 CFU/ECTS

65

Prerequisites
Basic notions of linear algebra (such as diagonalization of matrices) and of group theory (fundamental theorem of homomorphism).

Programme
Representations of groups, algebras, representations of algebras, subrepresentations, morphisms, direct sums.Irreducible representations, indecomposable representations, completely reducible representations. Tensor products, exterior and symmetric powers, duals, representiation structure on Hom spaces. Schur's lemma Characters and their main properties. First orthogonality relation. Characters are an orthonormal system. Invariance of multiplicities. Dimension of the space of central functions. Decomposition of the regular representation. Complex irreducible characters are an orthonormal basis for the space of central functions. Second orthogonality relation for characters. Orthogonality of matrix coefficients. Construction of irreducible representations for abelian groups. How to enumerate complex 1-dimensional representations in a finite group. The character table of the dihedral groups (n even). Induced representations and their character Explicit computation of induced characters. Frobenius reciprocity. Algebraic integers. More on the dimension of an irreducible representationFrobenius-Schur indicator. Enumerating involutions in a finite group. Compact groups and their representation theory; complex linear algebraic groups. Tangent vectors to an algebraic variety. Tangent bundle and tangent spaces. Linear

algebraic groups are smooth varieties. Lie algebras, derivations. The tangent space to a Linear algebraic group at the identity is a Lie algebra. Example: GL(n,C) The differential of a Linear algebraic group morphism is a Lie algebra morphism. Correspondence between semisimple Lie algebras and connected simply connected algebraic groups. Basic definitions of a Lie algebra: morphisms, representations, ideals and subalgebras. The adjoint representation and its subrepresentations. Derived subalgebra. Solvable and nilpotent Lie algebras. Nilpotent elements are ad-nilpotent. Engel's theoremLie's theorem and exercises on solvable Lie algebras. Some representation theory: dual representation, tensor product representation, representation structure on Hom(V,W). Irreducible representations of solvable Lie algebras. Schur's lemma. Irreducible representations of sl(2,C). Uniqueness of the Jordan decomposition in End(V)Jordan decomposition. Killing form. Cartan's solvability criterion.Cartan's semisimplicity criterion. Trace forms and Casimir element. Weyl's theorem.Cartan subalgebras. Abstract Jordan decomposition.Existence of Cartan subalgebras. Cartan subalgebras are self-centralizing. The root space decomposition. sl2-triples Reductive Lie algebras. Root strings. Euclidean structure on the real span of roots.Root systems and Weyl group.Strategy for the classification of classical Lie algebras. Simple Lie algebras have irreducible root systems and viceversa. Classical Lie algebras are simple. Serre's theorem. Uniqueness of the semisimple Lie algebra associated with a root system. Uniqueness of the root system associated with a classical Lie algebra. Universal enveloping algebra. PBW's theorem. Weights and finite dimensional representations.

Examination
Written exam. In case of doubt, a very brief oral session will be asked.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109789

RINGS AND MODULES

Second-cycle degree in Mathematics
Language: English
Teaching period: second semester
Lecturer: Riccardo Colpi
Credits: 6 CFU/ECTS

Prerequisites
Notions from the Algebra courses of the first two years of the degree in Mathematics and basic notions on module theory over arbitrary rings.

Programme
Additive and Abelian categories. Functor categories. Freyd-Mitchell embedding theorem. Pull-back and push-out. Limits and colimits. Adjoint functors. Categories of chain complexes and the homotopy category. Foundamental Theorem in homology. Left and right derived functors. The functors Tor, flatness and purity. The funtors Ext and Yoneda extensions. Flat, projective and injective dimensions of modules and their characterization in terms of derived functors. Applications to the global dimension of rings and Hilbert's syzygies Theorem.

Examination
Written exam with a discussion on the compositio

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109779

SEDIMENTOLOGY

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: second semester
Lecturer: Massimiliano Ghinassi
Credits: 6 CFU/ECTS

67

Prerequisites
Basic knowledge concerning sedimentology (textural features of the main types of sediments and sedimentary rocks) and stratigraphy (temporal and spatial variability of depositional systems).

Programme
1-Introduction to sedimentology (definition of facies and facies association, textural features of sediments, stratal geometries); 2-Processes of sediment transport and deposition (tractional transport by unidirectional and oscillatory currents; mass transport); 3- Post depositional modifications and soft-sediment deformations; 4- Continental depositional environments (alluvial, lacustrine and eolian); 5-Cosastal depositional environments (wave-dominated coasts, deltas, tidal flats); 6-Deep marine depositional environments (turbiditic and contouritic systems); 7- Sequence Stratigraphy (base level, systems tracts, key surfaces, incised valleys, non-marine sequence stratigraphy).

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1109937

STATIC ANALYSIS AND SOFTWARE VERIFICATION

Second-cycle degree in Computer Science
Language: English
Teaching period: first semester
Lecturer: Francesco Ranzato
Credits: 8 CFU/ECTS

68

Prerequisites
Basic knowledge of programming languages. Formally prerequisite courses are not required.

Programme
Operational program semantics. Denotational program semantics. Static program analysis by abstract interpretation. Dataflow program analysis. Software verification by model checking.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1176/2014/000ZZ/1109584

STATISTICAL METHODS FOR PROGRAMME EVALUATION

Second-cycle degree in Statistical Sciences
Language: English
Teaching period: first semester
Lecturer: Giorgio Brunello, Enrico Rettore
Credits: 8 CFU/ECTS

69

Prerequisites
This course consists of two parts:
part A presents the econometric tools required for the evaluation of public policies.
Part B presents several applications, with special reference to the areas of education and health.

Programme
Definition of causal effects
Evaluation of causal effects in an experimental setting
Evaluation of causal effects in an observational setting
Selection and design
Regression analysis and matching techniques
Instrumental Variables
Differece in difference methods
regression discountinuity
applications of these techniques in the area of education and health will
be provided in the secon part of the course

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2009/000ZZ/1094803

STATISTICAL MODELS

Second-cycle degree in Statistical Sciences
Language: English
Teaching period: second semester
Lecturer: Luisa Bisaglia, Carlo Gaetan, Nicola Torelli
Credits: 9 CFU/ECTS

70

Prerequisites
First year courses of the Laurea Magistrale degree in Statistical Sciences, especially Probability Theory, Statistics (advanced).

Programme
Generalized linear mixed models (3ECTS)
SECS-S/01
- Introduction to the course: basic ideas
- Generalized linear models: structure and inference
- Binary, multinomial and count data: some important applications
- Overdispersion in GLMs
- Introduction to hierarchical models and to GLMMs
- Likelihood inference in GLMMs Bayesian Hierarchical Models
- Introduction to (generalized) additive mixed models
- Practical sessions with R and R-Bugs

Nonparametric Smoothing Techniques (3ECTS)
SECS-S/01
- Density estimation
- Introduction of various smoothers
- Kernel regression
- Splines
- Parameter smoothing choice Multivariate extensions
- Computer labs

Time Series Analysis (3ECTS) SECS-S/03
- Introduction. Linear time series models.
- Linear time series models: model specification.
- Linear time series models: parameter estimation and forecasting.
- Linear time series models: extensions and

research developments.
- Nonlinear models: an introduction
- Nonlinear models: Markov-Switching Models and Threshold Autoregression Models

Examination
Written

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2014/000ZZ/1111773

STELLAR POPULATIONS

Second-cycle degree in Astronomy
Language: English
Teaching period: second semester
Lecturer: Gianpaolo Piotto
Credits: 6 CFU/ECTS

Programme
The color magnitude diagrams: transformations luminosity-magnitude and temperature-color index. Effects of the interstellar reddening on the color-magnitude diagrams.
The concept of stellar populations: historical background.
Population II CM diagram. Measurement of age and metallicity.
Globular Clusters stellar populations
The helium content of the population II stars.
The Galactic model by Eggen, Lynden-Bell and Sandage.
The galactic halo model from Searle and Zinn.
The interstellar medium near to the Sun and the local bubble.
The population I and the galactic disk. Open clusters and field population.
Dwarf Galaxies.
The mass function.
Integrated properties of the stellar populations.
Star formation History in galaxies
Basic principles of the chemical evolution of the stellar populations.
The supernovae: classification, evolution, progenitors.
The use of the supernovae as indicator distances.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1173/2010/001PD/1109407

STRATIGRAPHY

Second-cycle degree in Geology and technical Geology
Language: English
Teaching period: second semester
Lecturer: Nereo Preto
Credits: 6 CFU/ECTS

72

Prerequisites
Knowledges of sedimentary geology and clastic sedimentology; base knowledges of chemistry.

Programme
The aim of this course (or unit) is to make the student familiar with the sedimentary processes, depositional geometries, stratigraphy and diagenesis of carbonate systems. Besides, the student will be introduced to some specific methods of carbonate rock analysis, namely the study of carbonate microfacies and the stable isotope geochemistry (oxygen and carbon) of sedimentary carbonates. Programme: elements of physical oceanography and the inorganic carbon cycle; modes and products of carbonate precipitation in seawater; carbonate factories and carbonate platforms; depositional architecture and stratigraphy of carbonate systems; diagenesis of sedimentary carbonates and dolomitization; microfacies analysis of carbonate rocks; stable isotopic geochemistry of sedimentary carbonates and its application to the reconstruction of diagenetic histories.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1180/2009/000ZZ/1109939

SUPERCONDUCTING MATERIALS

Second-cycle degree in Materials Science
Language: English
Teaching period: second semester
Lecturer: Vincenzo Palmieri
Credits: 6 CFU/ECTS

73

Prerequisites
Solid State Physics

Programme
The course will start from the treatment of normal metal conduction both in d.c. regime and in radiofrequency regime and from that will immediately focus on the zero-resistance and on the diamagnetic behavior of superconductors. The two fluid model of a superconductor will be studied in detail and from that we will phenomenologically arrive to the need of Bose condensation and BCS theory. In the end of the course some applications of superconducting materials will be reviewed with special attention to the market of superconducting materials for particle accelerators.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1174/2013/000ZZ/1116659

SYMPLECTIC MECHANICS

Second-cycle degree in Mathematics
Language: English
Teaching period: first semester
Lecturer: Franco Cardin
Credits: 6 CFU/ECTS

74

Prerequisites
Elementary Calculus and Geometry

Programme
Essential of Differential Geometry and Exterior Differential Calculus. Cohomology.
Riemannian manifolds: Existence of metrics, Whitney theorem.
Symplectic Geometry: Symplectic manifolds. Introduction and developments of Hamiltonian Mechanics on symplectic manifolds.
Local and global parameterization of the Lagrangian submanifolds and their generating functions. Theorem of Maslov-Hoermander.
Hamilton-Jacobi equation, its geometrical solutions and links to the Calculus of Variations.
Conjugate points theory in calculus of variations.
Relative cohomology and Lusternik-Schnirelman theory. Introduction to Symplectic
Topology: existence and classification of critical points of functions and applications to generating functions of Lagrangian submanifolds.
The min-max solution of Hamilton-Jacobi equation. Morse theory.

Examination
Written.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1172/2011/001PD/1109786

THEORETICAL CHEMISTRY

Second-cycle degree in Chemistry
Language: English
Teaching period: second semester
Lecturer: Antonino Polimeno
Credits: 6 CFU/ECTS

75

Prerequisites
Basic knowledge in chemistry, physics and mathematics

Programme
The course introduces the basic theoretical skills for the comprehension of molecular processes in condensed phases, and for the interpretation of spectroscopic measurements. Methods will be exemplified in some cases using computer simulations. Classic (non-relativistic) mechanics methods for chemical systems, including molecular dynamics methods for the study of roto-translational motion in condensed phases. Quantum non-relativistic methods in chemistry, including angular momenta, group theory, Hartree-Fock, DFT, multiconfigurational approaches to electronic structures in molecules, linear response theory, stochastic approaches to molecular motions.

Examination
Oral and (optional) written paper on a chosen subject.

More Information
http://en.didattica.unipd.it/offerta/2014/SC/SC1169/2013/000ZZ/1116200

THEORY AND METHODS OF INFERENCE

Second-cycle degree in Statistical Sciences
Language: English
Teaching period: second semester
Lecturer: Alessandra Salvan / Nicola Sartori / Laura Ventura
Credits: 9 CFU/ECTS

Prerequisites
First year courses of the Laurea Magistrale degree in Statistical Sciences, especially Probability Theory, Statistics (advanced).

Programme
- Statistical models: approaches to inference, model specification, distribution problems, asymptotic approximations and delta method, simulation.
- Distribution theory: generating functions, moments and cumulants, moment approximations, variance stabilizing and skewness reducing transformations.
- Likelihood, observed and expected quantities: likelihood and sufficiency, invariance and exact sampling properties.
- Likelihood inference and first order asymptotics, nuisance parameters, non-regular models.
- Likelihood, computational aspects in R: Wald and deviance confidence intervals and regions, profile likelihood, simulation, numerical optimization methods.
- Introduction to Bayesian inference: prior information, posterior distribution, choice of the prior distribution, estimation, hypothesis testing and the Bayes factor.
- Estimating equations and pseudolikelihoods: misspecification, estimating equations, quasi likelihood, composite likelihood, empirical likelihood.
- Data and model reductions: sufficiency and completeness, ancillary statistics and conditioning, pseudo-likelihoods, marginal and conditional likelihood.
- The frequency-decision paradigm: statistical decision problems, efficient estimators, optimal tests and confidence regions, conditional inference and similarity.
- Exponential families: natural exponential families, mean value mapping and variance function, marginal and conditional distributions, sufficiency and completeness, likelihood quantities, conditional likelihood, profile likelihood and mixed parameterization, procedures with finite sample optimality properties, first-order asymptotic theory.
- Exponential dispersion families and generalized linear models.
- Group families: groups of transformations, orbits and maximal invariants, conditional and marginal inference.

Examination
1/3 homework. 1/3 final written exam, 1/3 paper and oral presentation reviewing one or two recent research papers.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SS1736/2014/000ZZ/1111802

THEORY OF FUNDAMENTAL INTERACTIONS

Second-cycle degree in Physics
Language: English
Teaching period: second semester
Lecturer: Andrea Wulzer
Credits: 6 CFU/ECTS

77

Programme
The course aims to provide a first introduction to the Standard Model of Electroweak and Strong interactions, discussing its theoretical foundations and the main experimental confirmations of its validity. An elementary knowledge of relativistic Quantum Field Theory and of the use of Feynman diagrams is required. Topics covered include: non-Abelian gauge theories; spontaneous breaking of global and local symmetries; formulation of the Standard Model theory; effective field theories and the Fermi theory of weak interactions; muon decay and neutral current scattering; physics at the Z pole (LEP); VCKM matrix and CP violation; unbroken symmetries in Quantum Field Theory; the QCD Lagrangian and its symmetries; semileptonic matrix elements and meson decays; the system of neutral Kaons, CP violation and GIM mechanism; asymptotic freedom and parton model; neutrino masses and oscillations; the Standard Model as an effective field theory and the Hierarchy Problem.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1171/2010/000ZZ/1095493

WIRELESS NETWORKS

Second-cycle degree in Computer Science
Language: English
Teaching period: first semester
Lecturer: Claudio Enrico Palazzi
Credits: 6 CFU/ECTS

78

Prerequisites
Computer Networks

Programme
This class offers an overview of issues related to systems and services on wireless networks. Main problems and protocol solutions available for wireless environments are analyzed, including possible alternatives regarding the state-of-the-art in wireless communication. Through the analysis of services that can be offered over wireless technology, the student will become aware of the future possible evolution and utilization of wireless systems.

Examination
Oral.

More information
http://en.didattica.unipd.it/offerta/2014/SC/SC1176/2009/000ZZ/1094552

University of Padova
School of Science

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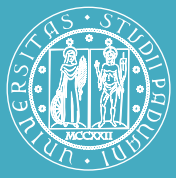

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