University of Padova
School of Medicine

CATALOGUE OF COURSES HELD IN ENGLISH

FOR ERASMUS, FOREIGN AND ITALIAN STUDENTS

academic year 2013 > 2014
## Master Degree of the School of Medicine Entirely Held in English

**Medical Biotechnologies**

## Master Degree of the School of Medicine with Courses Held in English

**Pharmaceutical Biotechnologies**

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**Master degree = Second-cycle degree**

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### For Courses Based on a Semester Organization

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### For Courses Based on a Trimester Organization

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Graphic design: Servizio Relazioni pubbliche
ADVANCED BIOMEDICAL TECHNOLOGIES
Master degree in Medical Biotechnologies
Language: English
Teaching period: 1st and 2nd semester
Lecturer: Fulvio Ursini
Credits: 8 ECTS
Examination: oral

- Spectroscopic techniques (including EPR and NMR).
- Advanced microscopy (including EM and AFM)
- Surface plasmon resonance for biomolecular interactions.
- Lipidomic (by MS/MS)
- Genome editing for gene therapy
- Principles of Cell Therapy

The course will be coordinated by the reference teacher and will include lectures and laboratory activity presented and guided by specialists in different fields.

CELL AND ORGAN PHYSIOLOGY AND MEDICAL PATHOPHYSIOLOGY
Master degree in Medical Biotechnologies
Language: English
Teaching period: 1st semester
Lecturer: Carlo Merkel
Credits: 8 ECTS
Examination: written

General overview
Liver as a biochemical laboratory
Liver as a vascular organ
Viral infections and the liver
Hepatocellular carcinoma
Inherited liver diseases
The heart and heart failure
The kidney and renal function
Acute renal failure
Chronic renal failure
Infectious diseases
**EXPERIMENTAL MODELS IN VIVO AND VITRO**

Master degree in Medical Biotechnologies  
Language: English  
Teaching period: 1st semester  
Lecturer: Andrea Porzionato  
Credits: 6 ECTS  
Examination: written

The post genomic era.  
Animal model organisms: invertebrates, fishes, amphibians, mammalians; The mouse as a model organism.  
Benefits of mouse for functional genomic studies in mammalians.  
General features of mouse;  
Transgenesis in mouse: gene transfer technologies and main fields of application of transgenesis in medicine.  
Use and applications of transgenesis through DNA microinjection in the ovocyte.  
Cell cultures and their applications.  
Features of a cell

**GENETICS**

Master degree in Medical Biotechnologies  
Language: English  
Teaching period: 1st semester  
Lecturer: Leonardo Salviati  
Credits: 6 ECTS  
Examination: oral

Organization of the human genome  
Genetic tests and their ethical issues  
Genetic drift. Founder effect. Selection.  
Hardy-Weinberg Law, Haldane’s Law, allelic frequencies.  
Classification of mutations and their nomenclature  
Nomenclature for reporting mutations  
Molecular bases of dominance and recessivity.  
Penetance and expressivity.  
Semidominant inheritance  
Digenic inheritance  
Analysis of genomic DNA vs. mRNA  
Point Mutations  
Deletions/Duplications  
Next generation sequencing in clinical setting  
Exome and genome sequencing  
“Classical” acceptance criteria  
In silico analyses, expression systems, hybrid minigenes, allelic frequencies  
Mitochondrial genetics  
Triplet expansion disorders.  
Genomic imprinting disorders.  
Molecular bases of Prader Willi and Angelmann syndromes. Diagnostic techniques.  
Structure of chromosomes  
Classification of chromosomal abnormalities  
Classical citogenetic techniques.  
CGH-Array and its problematics.  
Contiguous gene syndromes.  
Recurrent chromosomal abnormalities and their molecular bases  
Recurrence risk for chromosomal abnormalities  
Multifactorial disorders
“Immunology (ECTS 4) (Dr. A. Rosato)
Hypersensitivity reactions (type I-IV according to Gell and Coombs classification).
Transplantation immunology and transplant rejection.
Primary and secondary immunodeficiencies
Vaccination, vaccines and adjuvants
In vivo molecular imaging

General Pathology (ECTS 4) (Prof. L. Gorza)
Molecular pathology of diabetes and insulin resistance. Obesity and mechanisms of food intake regulation
Inclusion bodies. Huntington’s and Parkinson’s diseases
Molecular mechanisms of cardiac hypertrophy.
Mechanisms of heart failure.
Mechanisms of skeletal muscle atrophy.
Muscular dystrophies
Molecular and cellular biology of ageing.”
LABORATORY ACTIVITIES

Master degree in Medical Biotechnologies
Language: English
Teaching period: 1st and 2nd semester
Lecturer: Giorgio Palù
Credits: 8 ECTS
Examination: written

The course will consist in practical activities performed in selected research laboratories. The course will be coordinated by the reference lecturer and will also include lab meetings, lectures, and other related activities.

LABORATORY MEDICINE
TECHNOLOGIES AND MOLECULAR DIAGNOSTICS

Master degree in Medical Biotechnologies
Language: English
Teaching period: 2nd semester
Lecturer: Arianna Loregian
Credits: 14 ECTS
Examination: written

Molecular biology techniques based on nucleic acid amplification or hybridization; techniques to study DNA methylation; techniques for diagnosis of pathogenic microbes not based on molecular biology (isolation and identification of pathogenic bacteria, techniques for virological diagnosis not based on molecular biology); Therapeutic Drug Monitoring, TDM (pharmacokinetic parameters usually determined for TDM, methods for dosing drugs in biological samples, HPLC methods for dosing drugs, applications of TDM in diagnosis, practical lessons in a laboratory diagnostic unit performing TDM); techniques to test the sensibility in vitro of microbial pathogens to drugs; pharmacogenetics (basic principles and applications for diagnostic purposes, enzymes involved in drug metabolism, most common single nucleotide polymorphisms (SNPs) in the enzymes involved in drug metabolism and their pathogenetic relevance; microchips for diagnosis of these SNPs); Next Generation Sequence (NSG) technologies; applications of NSG technologies; microarray technology, applications of microarray technologies; presentation and discussion of scientific articles describing recent and novel diagnostic techniques and technologies.
NANOBIOTECHNOLOGY

Master degree in Medical Biotechnologies
Language: English
Teaching period: 1st semester
Lecturer: Camilla Ferrante
Credits: 6 ECTS
Examination: written and oral


Unit (ii) Bio-Imaging
Electromagnetic waves
Refractive index
Propagation laws
Optical systems and image formation
Fluorescence: molecular aspects
Conventional fluorescence microscope
Point Spread Function (PSF) and resolving power of the microscope
Confocal Microscopy
Multiphoton Microscopy
STED Microscopy
Ca2+ Imaging
FRET
FRAP

PHARMACEUTICAL BIOTECHNOLOGY: DESIGN AND ANALYSIS OF BIOPHARMACEUTICALS

Master degree in Medical Biotechnologies
Language: English
Teaching period: 2nd semester
Lecturer: Claudia Sissi
Credits: 6 ECTS
Examination: oral

“Biodrugs: basic concept; production; purification; storage Evaluation of the potential application of pharmacologically active macromolecules Optimization of pharmacologically active macromolecules combinatorial approaches relevant examples (enzymes, hormones, antibodies, nucleic acids) Data analysis electrophoretic techniques (2D; sequencing, EMSA, CE) Spectroscopic techniques (CD, Fret, fluorescence quenching) Microcalorimetric techniques (ITC, DSC) Biosensors (SPR) computational tools
**PHARMACOLOGY AND MOLECULAR THERAPIES**

Master degree in Medical Biotechnologies  
Language: English  
Teaching period: 2nd semester  
Lecturer: Giorgio Palù, Maria Cristina Parolin  
Credits: 14 ECTS  
Examination: written and oral

“Pharmacology” (4 ECTS)  
Part I (Pharmacokinetics): absorbance; bioavailability; drug distribution; processes of bio-transformation; acute and chronic therapy; half-time of elimination; renal and extra-renal clearance.  
Part II. Pharmacogenetics and Pharmacogenomics: variability in the response to drugs due to genetic factors; polymorphism of metabolizing enzymes, receptors, transporters; genetic traits of diseases with influence on the response to drugs; biomarkers predicting toxicity to drugs. Drug discovery and development.  
Toxicology: classification criteria, organ-specific toxicity, mechanisms of drug-induced toxicity, immune reactions; idiosyncrasy; genotoxicity; teratogenesis.

“Molecular Therapies” (10 ECTS)  
Gene and Cell Therapy  
Advanced molecular therapies.  
Concepts and tools of gene and cell therapy.  
Delivery systems and therapeutic strategies for cell and gene therapy.  
Development and application of virus-based vectors.  
Oncolytic viruses for treatment of cancer.  
Application of gene therapy to non neoplastic disorders.  
Gene therapy approaches for HIV-1 infection.

Clinical trials and regulatory issues.  
Intellectual property management.  
R&D organisation in companies.  
Product development in preclinical phase.  
Product development in clinical phases.  
Rare diseases and Orphan drugs.  
Stem cell-based therapies.  
Stem cell-based therapies as “medicinal products” and manipulation. according to GMP.  
Advances in corneal surgery and cell therapy.  
The human ocular surface and Limbal Stem Cell Deficiency (LSCD).  
Techniques for Culture, Assessment and Preservation of Limbal Stem Cell Grafts.  
Limbal stem cells and clonal analysis.  
Impression Cytology.  
Evaluation of the percentage of stem cells in cultured grafts.  
Q-FIHC assay: application in manufacturing and research of corneal stem cells.  
Evaluation of endotoxin content, mycoplasma, and viral contamination to reduce post-grafting inflammatory responses.  
Outcome of autologous cultured limbal stel cells grafts.  
Long-term follow-up of regenerated corneal epithelium.  
Nucleic acids as drugs and drug targets.
PROTEOMICS AND BIOINFORMATICS

Master degree in Medical Biotechnologies
Language: English
Teaching period: 1st semester
Lecturer: Stefano Toppo
Credits: 6 ECTS
Examination: written

Organization of the human genome
Genetic tests and their ethical issues
Genetic drift. Founder effect. Selection.
Hardy-Weinberg Law, Haldane’s Law, allelic frequencies.
Classification of mutations and their nomenclature
Nomenclature for reporting mutations
Molecular bases of dominance and recessivity.
Penetrance and expressivity.
Semidominant inheritance
Digenic inheritance
Analysis of genomic DNA vs. mRNA
Point Mutations
BIOCHEMICAL CONCEPTS
Basic concepts on general properties of amino acids, secondary structures, protein domains
Interactions forces in proteins from quantum chemistry to molecular mechanics and dynamics
Introduction to force fields in molecular mechanics and the different interaction forces bonded and non-bonded. Protein folding from Anfisen to modern theories
Protein folding in the cell

MASS SPECTROMETRY IN PROTEOMICS
Mass spectrometry MS
Description of MS instrumentations
Mass Spectrum interpretation
Fragmentation rules and ion series
MS fingerprinting and MS/MS data identification analysis
Interpreting a MS/MS spectrum
Parametric and non-parametric methods, FDR, decoy sets, spectral clustering
Mass spectrometry quantification techniques
Signal processing, statistical analysis, normalization, Clustering and classification,
Gene Set Enrichment Analysis (GSEA),
Hypergeometric testing, Statistical experiment design

BIOINFORMATICS
Sequence alignments algorithms
Brief introductions to issues and unsolved questions from phylogenetic analysis to protein structure and function.
Dot Plot analysis, repeat and inverse repeats
Sequence alignment scores: random vs. match model to calculate the alignment score
Scoring matrices
Local (Smith and Waterman), global (Needleman-Wunsch), freeshift algorithms
K-tuple algorithms
Confusion matrices, ROC curves
Multiple alignments
Patterns
Frequency matrices and protein profiles
PSI-BLAST and the PSSM
Markov chains and Hidden Markov Chains (HMM).
Brief introduction to secondary protein structure prediction
Brief introduction to structural modeling from comparative modeling to fold recognition techniques
Visualizing proteins in 3D with molecular visualization systems
### STEM CELL BIOLOGY AND MOLECULAR BIOLOGY OF DEVELOPMENT

- **Master degree in Medical Biotechnologies**
- **Language:** English
- **Teaching period:** 1st semester
- **Lecturer:** Sirio Dupont
- **Credits:** 6 ECTS
- **Examination:** written


### ADVANCED ORGANIC CHEMISTRY

- **Master degree in Pharmaceutical Biotechnologies**
- **Language:** English
- **Teaching period:** 1st semester
- **Lecturer:** Marcella Bonchio
- **Credits:** 4 ECTS
- **Examination:** written/oral

MOLECULAR BIOLOGY II

Master degree in Pharmaceutical Biotechnologies
Language: English
Teaching period: 1st semester
Lecturer: Dorianna Sandonà
Credits: 6 ECTS
Examination: written and oral

- Epigenetic and monoallelic gene expression: epigenetic markers and “Histone code”, genomic imprinting and developmental disorders, X chromosome inactivation, monoallelic gene expression,
- Post transcriptional gene regulation by small RNAs: expression, processing and mechanisms of action of microRNA., microRNA involvement in organism development, cancer, other pathologies; interfering RNAs, RNA interference as a tool to study genes, RNAi and therapeutic perspectives
- Molecular therapy of cancer: the molecular basis of cancer, cancer and epigenetic, new approaches for the molecular therapy of cancer, immunologic therapy of cancer, DNA vaccines.
- Treatments able to modify the RNA transcript or able to alter protein translation: molecular basis of Duchenne and Becker muscular dystrophies, frame shift and nonsense mutations, exon skipping, oligonucleotides as drugs, oligonucleotides delivery; the nonsense mediated mRNA decay, stop codon read through, molecules able to induce stop codon read through.
- Recombinant protein production: expressing vectors, bacteria, yeast and mammalian cells as guest organisms.
- Practical experience: transfection of the cDNA encoding the Green Fluorescent Protein (GFP) in human model cells and silencing of GFP by RNA interfering, definition of appropriate controls. Determination of GFP expression by western blot and fluorescence confocal microscopy analyses.

Examination
1. Bibliographic search and oral presentation of the results regarding a particular aspect of a program topic.
2. Written report on the practical part of the course
3. Oral examination regarding the course topics
The course covers the following topics:
- General principles of biotech processes applied to the production of proteins for therapeutic use. Production and downstream processing of Biotech Therapeutics. Good Manufacturing Practices (GMP) for biotech drugs.
- Biosimilars

**Examination**
Oral Presentation by students (monograph assignment on biologics recently approved or in clinical trial)/Multiple choice test

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The course focuses on the molecular basis of target-based drug discovery, with emphasis on the biological targets of therapeutic relevance for rational discovery & development of small molecules drugs.

Topics covered through the course are:
- Principles governing drug-receptor interactions, molecular mechanism of drug-receptor recognition, stereochemistry.

Discovery of Lead compounds, structure-activity relationships.

Rational development of drugs: natural products and existing drugs as chemical scaffolds for the discovery and design of novel therapeutics, analog design, computer-aided rational design, peptidomimetics.

Examples treated in details will be benzodiazepines, opioid analgesics, renin-angiotensin-aldosterone inhibitors, Histamine-2 antagonist, COX-inhibitors and kinase inhibitors. Particular attention will be devoted to the discovery and development of HIV-protease inhibitors and sialidase inhibitors, and in general to the development of antibacterial and antiviral drugs.
MICROBIAL DIAGNOSTIC METHODS AND IMMUNOCHEMISTRY

A. MICROBIAL DIAGNOSTIC METHODS
Master degree in Pharmaceutical Biotechnologies
Language: English
Teaching period: 1st semester
Lecturer: Antonella Caputo
Credits: 6 ECTS
Examination: written/oral
The course covers the following topics:
- Concepts on: bacteria, virus, mycetes and protozoa of medical interest, biotechnological drugs, direct and indirect diagnostic procedures, safety procedures in a microbial laboratory, microbial procedures, including
  1) samples collection, storage and delivery;
  2) methods for isolation and identification of bacteria; 3) methods for virus isolation and identification; 4) methods for isolation and identification of mycetes and protozoa;
  5) methods of molecular diagnostics; 6) immunological methods.

B. IMMUNOCHEMISTRY
Master degree in Pharmaceutical Biotechnologies
Language: English (upon request)
1st semester
Lecturer: Susanna Mandruzzato
Credits: 4
Examination: written/oral
The course covers the following topics:
The course deals with molecular biology and chemicals methods that can be used to study protein structure and function and to develop proteins with new and useful properties.

The course covers the following topics:

- Site-directed mutagenesis of proteins to increase their thermodynamic stability
- Chemical stability of proteins and strategies to improve it
- Methodologies to create libraries of mutants (directed evolution) and methods of high-throughput screening
- Antibodies, antibody fragments and new binding proteins developed from non-immunoglobulin domains
- Circular permutation of proteins
- Inteins and their applications
- Chemical synthesis of peptides and proteins
- Production of proteins and peptides containing non-natural amino acids.

All techniques will be illustrated with examples of applications.
The course firstly introduces polymers and their characteristics, facilitating the comprehension of the drug delivery systems. Liposomes, hydrogels are discussed as drug delivery system together with the definition of their physico-chemical properties. The biotech drugs are introduced firstly from the legal point of view taking into consideration also the biosimilar definition. Then the advantages and problems of biotech drugs are presented. The several solutions to overcome the limits of biotech drugs are presented. Firstly, the main parameters for the development of a protein formulation are described and then the lyophilization process is introduced. Secondly advances methods of protein delivery are introduced with particular emphasis to protein conjugation with polymer and fusion proteins. Finally the some approaches of gene delivery are presented.

The experimental section is carried out in the laboratory involving the preparation of liposomes, hydrogels and conjugation.
Program and content of the course:
Amino acids properties
Protein primary structure
Protein secondary structure
Protein Domains
Protein tertiary and quaternary structure
Chemical bonds, forces and interactions in proteins
Protein Folding
Protein Unfolding
Protein Misfolding
Intrinsically disordered protein
Protein-protein interaction and surface plasmon resonance
Membrane protein
Transport across membranes, Endocytosis and involved proteins
Spectroscopy and determination of protein structure
Fluorescence: theory
Applications
Circular dichroism: theory
Applications
Infrared
X Ray and crystallography.