Applications of biotech on medicine

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 7.0

Term or Semester 2° semester

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Goals
The aim of the course is to provide students with a basic theoretical understanding of some fields of biotechnological applications in medicine, namely vaccine technology, epigenetics applied to occupational medicine, reproductive medicine, forensic medicine, cell culture and stem cell technologies.

Acquired skill
Understanding and analysis of basic biological phenomena and methodologic approaches to their study in relation to current or possible biomedical applications

Program with reference to descriptor 1 and 2

Biotechnology of reproduction
- Ovarian and endometrial cycle– spermatogenesis- conception
- Implantation, development and function of the placenta - Fetal growth – Main embryo and trophoblast pathologies–pregnancy related diseases
- Causes of infertility and clinical indications to assisted reproduction - in vitro assisted reproduction techniques
- Crioconservation of gametes and reproductive tissues – stem cells for reproductive purposes – preimplantation diagnosis – Genomic imprinting
- Invasive and non-invasive prenatal diagnosis techniques – reproductive techniques in couples with blood viral infections

Forensic Science and the role of experts in the Italian Legal system.
- Basics of admissibility standards of expert evidence in the Italian and North American legal systems.
- Introduction to Forensic genetics. The medico-legal approach to biological evidence: presumptive and confirmatory tests and screening for biological components, species, sex and personal DNA identification.
- The collection and storage of biological evidence. The chain of custody.
- Molecular basis of human DNA identification: length and sequence polymorphisms. Autosomal and lineage markers (Y chromosome and Mitochondrial DNA polymorphisms).
- The process of forensic validation.
- Introduction to the interpretation of evidence based on DNA profiling and in paternity testing.
- Future perspectives in forensic DNA analyses.

Introduction and General Concepts.
Technologies for DNA Methylation and Histone Modification Analyses.
Epigenetics: Environmental Instructions for the Genome.
Design of Epidemiology Studies and Epigenetic Aging
Health Correlates of Epigenetic Alterations, Genomic Imprinting and Epigenetic Inheritance.
Diet and Epigenetic States. Epigenetics and Cancer.
Epigenetics Alterations of Cardiovascular, Respiratory and Neurological Diseases.
Non-coding RNAs.

Cell and tissue culture methods, laboratory and requirements.
Tissue and cells bank, cryo-preservation
Cell culture in biomedical diagnosis (amniocytes culture, fibroblasts culture)
Cell culture in biomedical research
tumor invasion and metastasis
signal transduction
Hematopoietic cells
Tumor stem cell
Cell migration: molecular mechanisms and in vitro models
Cell death: methods to study apoptosis and necrosis
Integrins extracellular matrix, growth factors: characteristic and dynamic changes
during tumour progression; and targets for new cancer therapeutics.

Program's information
Bibliografie selezionate attinenti agli argomenti trattati saranno fornite a lezione

Applied physics

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 9.0

Term or Semester 2° semester

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Goals
The purpose of this course is twofold:
- Consolidate the basic concepts essential for understanding molecular and biomolecular phenomena and technologies. Particular emphasis will be given to thermodynamics and to the proper use of the concept of energy;
- Introduce the basics of fluorescence and of optical microscopy, thereby allowing a proper understanding of some biotechnological basic methodologies.

Acquired skill
In this class the student: (i) learns about the physical quantities of importance in the field of Biotechnologies, with a specific emphasis on thermodynamic quantities, and about their units of measurements; (ii) learns to use such quantities in quantitative problems; (iii) learns about the physical and technological foundations of optical microscopy and fluorescence.

Program with reference to descriptor 1 and 2
Introduction to quantitative description of motions
Introduction to the physical quantities and to the proper use of their transformations
Description of the motion of bodies: space dimensions, velocity, acceleration, decomposition of the motion along orthogonal axes, parabolic motion, range of a projectile
The three laws of motion, the definition of mass and strength
Introduction to different types of forces: weight, static and dynamical friction force, reaction force, elastic force
Introduction to the description of the fluids: pressure in a fluid, Stevino law, Archimedes force, the viscous friction (definition and viscous friction force on a sphere)
Work of forces
Kinetic energy theorem
Conservative and non-conservative forces
Potential energy (with examples containing elastic force and weight)
Conservation and dissipation of mechanical energy, definition of power

Thermodynamics
Zero law of thermodynamics: thermal contact
Thermometers and definition of thermometric scales (Kelvin and Celsius)
Heat and calorie
Thermal contact and thermal equilibrium
State equation of an ideal gas
Kinetic theory of gases (microscopical description of temperature, principle of energy equipartition)
Equivalence of work and heat (Joule experiment)
First law of thermodynamics
Transformations of an ideal gas (isothermal, isobaric, isochoric, adiabatic)
Internal energy and interaction potential
Thermalization and Boltzmann distribution (activated dynamics)
Random walk (and random chain) and diffusion (diffusion coefficient, Fick's law)
Second law of thermodynamics (Clausius, Kelvin)
Carnot cycle, thermal engine and yield
Definition of entropy
Irreversible processes in an isolated system (free expansion, thermalization of two bodies in contact), yield of irreversible engines, lost work and energy degradation

Statistical description of entropy (the configuration and velocity space)

Free energy

Electrostatic and optics
Electric charge and Coulomb force,
Electrostatic potential energy, electric field, electric potential
Insulating and conducting materials (metals and electrolytes)
Electric current, resistance, global and local Ohm's laws
Joule effect
Nature of electromagnetic radiation: frequency, velocity of propagation, wavelength, wavevector
Spectrum of the radiation, light radiation, radiation power
Polarization
Refractive index, refraction, total reflection

Physical basis of fluorescence and optical microscopy
Introduction to the concept of images and optical image formation by lenses.
Convergent and divergent lenses. Real and virtual images. Lens aberrations (chromatic aberration, spherical aberration, field curvature).
Main properties of most used light sources (incandescent lamp, arc lamp, led and laser) and light detectors (photodiodes, CCD, photomultipliers).
Introduction to light spectra. Methods of discriminating wavelengths in a spectrum (dichroic filters and diffraction gratings).
Introduction to spectral measurements and to the basic structure of the spectrophotometer.
Introduction to fluorescence and to the basic structure of fluorimeters. Introduction to FRET.
Introduction to the structure of optical microscopes: optical components and microscope geometries; conjugated planes.
Magnification and resolution. Role of the numerical aperture in the resolution.
Illumination in the microscope. Use of the condenser.
Microscopy in bright field and in dark field, fluorescence microscopy, polarized microscopy, phase contrast microscopy.

Program's information
Sul sito del corso sarà disponibile un elenco molto dettagliato degli argomenti del corso, con commenti ed approfondimenti.
Tale elenco serve per reperire materiale di studio sugli argomenti trattati all'interno di testi universitari di fisica.
Non c'è un testo unico di riferimento, poiché gli argomenti trattati si trovano con facilità in tutti i testi universitari di fisica per scienze biologiche.

Biochemistry and fundamentals of human biochemistry

Degrees:
\[ D47 \quad \text{Medical Biotechnology (Classe L-2)} \quad \text{total credits } 11.0 \]

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Goals
The course aims to provide the knowledge necessary for the understanding of the biochemical processes underlying cell function and body.

Acquired skill
Knowledge and understanding of a) structure and functions of macromolecules, mainly referring to proteins; b) composition organization and dynamics of biological membranes, mainly referring to membrane transport e signal transduction mechanisms; c) cell metabolism, regulation and integration of metabolic pathways in human cells.

At the end of the course, student will acquire the capacity to understand the relationship between tissue metabolism and function; the ability to recognize and predict metabolic adaptation to altered environmental conditions (including fuel availability) also in view of following courses, such as general pathology and farmacology.

The acquisition of these knowledges and skills will be certified by passing the exam

Program with reference to descriptor 1 and 2
STRUCTURE COMPOSITION ORGANIZATION
The biochemical logic of living matter
Cellular, chemical, physical, genetic and evolutionary bases.
Water and weak interactions in aqueous systems
Proteins. Structure and function.
Structural elements and three-dimensional protein organization.
Globular proteins.
Kinetic and thermodynamic folding of proteins, assisted folding: disulfide isomerase, chaperonine.
Oxygen-bound proteins: myoglobin and hemoglobin.
Oxygen transport in the blood
Immunoglobulins: Antigen-antibody interaction.
Enzymes: how enzymes work; Co-enzymes and water-soluble vitamins; Factors affecting enzymatic activity; Enzymatic kinetics; Regulation of enzymatic activity.
Compartmentation and Communication in Biochemical Processes
Biological membranes, composition, organization and dynamics of membranes.
Transmission systems of molecules and ions through the membrane.
Biosignalization: Signal translation mechanisms.
Membrane receptors coupled to G protein and second messengers; Receptors with enzymatic activity, protein domains, and multiprotein complexes in signal translation
BIOENERGETICS AND METABOLISM
Introduction to Metabolism.
Metabolism organization: catabolism and anabolism.
Principles of bioenergy.
Compounds with high energy content; Transfer of phosphorous groups and ATP.
Organic oxides.
Oxidative phosphorylation
Transport of electrons into mitochondria; ATP synthesis; ATP-ADP translocated.
Adjustment of oxidative phosphorylation.
Carbohydrates
Mono- and disaccharides; polysaccharides.
Digestion and absorption of carbohydrates.
Glycolysis: the fate of anaerobic and aerobic pyruvate.
Adjustment of glycolysis.
Common intermediate acetyl-CoA of oxidative processes.
Tricarboxylic acid cycle and its regulation.
Synthesis and degradation of glycogen.
Glycogenolysis and glycogen synthetization regulation.
Glycoconjugates.
Proteoglycans, glycolipid glycoproteins.
The oligosaccharide chains in the cellular information mechanisms.
Lipids
Simple lipids and complex lipids.
Essential lipids.
Digestion and lipid absorption
Lipid transport: lipoproteins.
Lipolysis, oxidation of fatty acids and their regulation.
Formation of the ketone bodies.
Biosynthesis of fatty acids and triglycerides and their regulation.
Cholesterol metabolism and its regulation.
Cholesterol Derivatives: biliary acids, steroid hormones
Phospholipids and glycolipids: metabolism and function
Lipids as signal molecules: eicosanoids, sphingolipid mediators
Proteins and Nitrogen Compounds *
Digestion and protein absorption.
Biological value of proteins.
Essential amino acids.
Nitrogen balance.
Turnover and intracellular protein degradation.
Synthesis and degradation of amino acids.
Glucose and ketogenic amino acids.
Ammonia metabolism.
Urea cycle.
gluconeogenesis; Coordinated regulation of gluconeogenesis and glycolysis.
Ketogenesis.
Molecules derived from amino acids.
Creatine, biogenic amines, nitrogen oxides.
Synthesis and degradation of the eme group.
Synthesis and degradation of purine and pyrimidine nucleotides.
Uric acid.
MOLECULAR BASES OF THE CONTROL OF CELLULAR ACTIVITIES
Adjustment of transcription: Growth factors and steroid hormones.
P13K / Akt signaling path
Cell cycle regulation: cyclin and cyclin-dependent kinase kinases
Oncogenes, tumor suppressors. Planned cell death.

* The nucleic acid biosynthesis (RNA and DNA) and proteins and regulation of gene expression will be treated in the course of Molecular Biology

Nutrition Principles
Energy requirements, macronutrients, water-soluble and liposoluble vitamins, trace elements.
Hormone regulation and metabolic integration in humans
Hormone structures, functions.
Hormonal regulation of energy metabolism.
Homeostasis concept; interrelations and metabolic integrations between different tissues; fast-feeding cycle, prolonged fasting and stress conditions, exercise.
Basic acid balance and its regulation.
Calcium homeostasis: cellular and systemic homeostasis
Iron metabolism
Sensory systems
Molecular mechanisms of vision, smell, taste, and tact
Oxygen Reactivity
The reactive species of oxygen, nitrogen and oxidative stress
Damage caused by radicals
Antioxidant defenses

Program's information

Si consiglia uno di questi testi a scelta:
I Principi di Biochimica di Lehninger IV edizione, Nelson D.L., Cox M.M., Zanichelli Editore
Fondamenti di Biochimica II edizione, Voet J.G. Voet D., Pratt C.W., Zanichelli Editore.
Biochimica VI edizione, Berg J., Tymoczko J.L. Stryer, Zanichelli Editore
Biochimica per la discipline biomediche II edizione, Baynes J.W e Dominiczak M.H., Casa Editrice Ambrosiana.
Biochimica Medica III edizione, Siliprandi N. Tettamanti G., Piccin Editore.

Bioethical and legal issues in biotechnology

Degrees:
- D47 - Medical Biotechnology (Classe L-2): total credits 9,0

Term or Semester 2° semester

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Short Course Description

Goals
The objective of the course of Biotechnological Applications in Medicine is to provide students with a general overview of current applications in the fields of forensic medicine, reproductive medicine, regenerative medicine, environmental epigenetics and vaccine technology

Acquired skill
The course will provide students with information on the main mechanisms of disease and the underlying cellular and molecular processes. Specifically, at the end of the course students will have acquired skills and knowledge related to the main forms of cell degeneration, tissue damage processes and regeneration/healing, local and systemic effects of acute and chronic inflammatory reactions, immunomedioted processes of innate and adaptive nature, interaction and defense against infectious agents, neoplastic transformation and host responses to tumors.

Program with reference to descriptor 1 and 2

Preliminary notions
The Constitutional Charter
The sources of law
The judicial system in Italy
Criminal protection of the person and of the health
The structure of the offense
The cause of the cause
Voluntary, crippled and pretestuous murder
Criminal liability in the bio-medical field
The probative assessment of criminal liability in the bio-medical field
The protection of the person and of the health in the field of civil engineering
Concepts of birth and death in Italian legal order
The ability to act
The constituent elements of the contract and its effects
The right to health and consent to the medical act
Legislation on organ transplantation
Protecting people’s ideas
The concept of intellectual property
The recognition of intellectual and industrial property
The system of trademarks and patents
Protection actions

Evolution of the concept of health
Fundamentals of welfare systems at public level: how to look at funding
Configuring welfare systems and spending on health
The evolution of health and European legislation over the past 30 years
Biotechnologies in molecular diagnostics and fundamental of statistics

Degrees:
- D47 - Medical Biotechnology (Classe L-2);
moduli/unità didattiche: Modulo: Biotecnologie in diagnostica, Modulo: Statistica nella sperimentazione biomedica total credits 9,0

Term or Semester
1° semester

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Goals
Stressing the role of biotechnology in the health sector, the overall objective of the course is to increase our knowledge of the main techniques that have been used or will be used in the near future in the advanced diagnostics in vivo and ex vivo. This objective is supported by the study of the fundamental principles of statistics, essential for the understanding of the basic concepts of laboratory medicine.

Acquired skill
The broader objective of this course is to provide, not only knowledge but, the capacity to integrate acquired information provided by different sections of the clinical diagnostic laboratory (biochemistry, clinical pathology, statistical data analysis) to select methodologies, to analyse and interpret data and finally to transfer such findings into a to a final diagnostic management plan. Students will be able not only to demonstrate that they know but also to critically select their specific interest in different fields of the molecular diagnostic management.

Module:
Program with reference to descriptor 1 and 2
- Laboratory principles 1: general laboratory techniques, procedures and safety
- Laboratory principles 2: specimen collection and other preanalytical variables
- Principles of clinical enzymology and diagnostic applications
- Principles and immunochemical techniques and protein arrays
- Nucleic Acids 1: gene expression profile and clinical applications
- Nucleic acids 2: Metods for genotyping and epigenetic analysis
- Principles of capillary zone electrophoresis and HPLC and clinical applications
- Mass spectrometry
- Proteomics techniques for proteome profling of cell and tissue extracts
- Proteomic techniques for proteome profiling of biological fluids and possible clinical applications
- Principles for post transductional modifications analysis and their clinical significance
- Techniques in surgical pathology
- Techniques in immunohysto-cytochemistry
Techniques in molecular pathology and their clinical implication: Fluorescence in situ hybridization (FISH) analysis - Staining in pathology.
General introduction about “biomarkers” concept. Tumor biomarkers
Diagnostic biomarkers of metabolic disease
Cytokines and chemokines as disease biomarkers
Cytokines and chemokines as bone remodelling biomarkers.
The new concept of “Osteoimmunology”
Matrix metalloproteinases as new bone remodelling biomarkers.
General revision and course closure

Module:
Program with reference to descriptor 1 and 2
- Non-invasive imaging techniques, Radiography Computed Tomography, PET/SPECT, MRI
- Biomarker Imaging with contrast agents and tracers
- Animal models and Molecular Imaging
- Reporter genes and transgenic animals
- Imaging of Reporter Gene expression (Bioluminescence, Fluorescence, PET, MRI)
- Cell labeling and imaging
- Statistics and the Scientific Method
- Measurement scales
- How to represent data: position and variability indexes.
- Accuracy and precision.
- Biological and analytical variability
- Laboratory measurement and statistical models
- Statistics as measurement method: model estimation
- Confidence Intervals
- Association and dependence
- Calibration of measurement methods and Regression
- Experimental design and Analysis of Variance
- Concordance between measurement methods.
- Diagnostic testing. Sensitivity, Specificity and ROC.
- Diagnostic predictive values and likelihood ratios
- Statistical hypothesis testing
- Assessment of the efficacy of a diagnostic or therapeutic procedure.
- Biostatistics and Genomic bioprofiling.

Training
- Calculus spreadsheet and Software R for Biostatistics: Descriptive Statistics, use of graphics and indexes in biomedical studies.
- Sampling and Gaussian, Exponential and Poisson distributions in Biology
- Point and interval estimation in the biotechnology lab
- Bioanalytical use of regression: calibration.
- Analysis of Variance and concordance between laboratory methods
- Diagnostic test assessment, ROC and Fagan nomogram
- Application of single and multiple statistical testing on experimental data,
- Bioprofile analysis on genomic data: differential expression and cluster analysis.

General and cellular biology
Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 7,0

Term or Semester 1° semester

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Goals
This course aims to provide students with the basic knowledge of fundamental characteristics of living organisms. In particular, it aims to provide students with the basic knowledge of fundamental biological structures – biological molecules, cells, tissues – and their functioning.

Acquired skill
At the end of the course, students will gain knowledge of the main inorganic and organic components of living organisms, nucleic acid and protein synthesis and related basic regulation, the main functions of nucleic acids and proteins, and transmission of information from DNA to proteins, both in prokaryotic and eukaryotic cells. Students will also gain knowledge of the molecular organization and functions of subcellular organelles and membrane systems in both prokaryotic and eukaryotic cells as well as cell division processes of eukaryotic cells.

Program with reference to descriptor 1 and 2


Practical courses and seminars:
DNA replication: the Meselson-Stahl experiment.
Introduction to biology laboratory
Rudiments of light and fluorescence microscopy.
Viewing of living cells in culture and of fixed and stained cells by light microscopy.

Program's information

General and inorganic chemistry

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 8,0

Term or Semester 1° semester

Goals
The course aims at furnishing the basic concepts crucial for the understanding of chemical structures and properties of the most important chemical compounds in the environment together with the rules which determine their chemical and physical transformations. These concepts are essential for the proper understanding of later courses which have the General and Inorganic Chemistry as a bridging course. The course provides also the necessary manual skill in some laboratory elementary processes, a key point for a biotechnologist.

Acquired skill
Attending to this course, the student acquires the language and the fundamental knowledges necessary for his/her basic chemical education. These knowledges will be applied to more specific chemical and biochemical courses in the further years of Medical Biotechnologies.

Program with reference to descriptor 1 and 2
Frontal lessons:

Practice sessions:
In the classroom: weight and volumetric calculations for chemical reactions. Derivation of the chemical composition of systems at equilibrium, particularly in the case of acid-base and complexation equilibria.

Program's information
Gli studenti avranno a disposizione un sito internet dove regolarmente verrà pubblicato materiale utile per la preparazione dell’esame e l’approfondimento dei temi trattati in aula: le slides delle lezioni, i temi d’esame di anni precedenti, le risoluzioni di alcuni problemi tratti dai temi d’esame di anni precedenti, il registro delle lezioni con l’argomento trattato giornalmente in ogni lezione, links utili a siti di Chimica Italiana, inglesi e americani.

Libri di testo consigliati:
N. J. Tro, Chimica un Approccio Molecolare; Ed. EdiSES
K. W. Whitten, R. E. Davis, M. L. Peck, G. G. Stanley Chimica; Ed. Piccin
P. Atkins, L. Jones Chimica Generale; Ed. Zanichelli
P. Michelin Lausarat, G. A. Vaglio Stechiometria per la Chimica Generale, Ed. Piccin

- 8 -
General biology

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 8,0

Term or Semester 1° semester

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Prof. PAGANI MASSIMILIANO, Medical Biotechnology and Translational Medicine
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Goals
With this course students will acquire the fundamental knowledge of the molecular mechanisms regulating the maintenance of genetic information and its decoding. Both prokaryotic and eukaryotic cells will be considered.

Acquired skill
The course aims to provide the knowledge of the main techniques of molecular biology and the ability to properly use them for the theoretical resolution of specific biological problems, remembering to set up in each experimental phase the appropriate positive and negative controls.

Program with reference to descriptor 1 and 2

Lectures:
- Biological macromolecules: DNA, RNA, proteins (structure, function and purification techniques).
- Model organisms for molecular biology studies.
- Major molecular biology techniques for the analysis of DNA, RNA and proteins and their manipulation (hybridization of nucleic acids, Southern, Northern, in situ hybridization, DNA sequencing, PCR, qPCR, SDS-PAGE, Western blot, production of monoclonal and polyclonal antibodies, HIC, lp, chIP, a mention of the transcriptome).
- DNA topology and topoisomerases.
- Chromatin condensation: nucleosome structure and higher levels of condensation.
- Epigenetics: basic concepts.
- Brief review of transcription in prokaryotes: transcriptional apparatus; structure of the promoters and regulatory mechanisms. The cycle of transcription.
- Transcription in eukaryotes: structure of the transcriptional apparatus, promoters and regulatory mechanisms.
- Non coding RNAs: synthesis and function.
- RNA splicing: molecular mechanisms.
- Translation in prokaryotes and eukaryotes.
- DNA replication in prokaryotes and eukaryotes.

Exercises:
Groups of 4-5 students will be provided with experimental projects to be developed using the knowledge acquired during the course. At the end, each group will prepare a manuscript containing a brief introduction of the scientific problem followed by a detailed description of the chosen experimental approaches, the techniques used and the corresponding controls.

Program's information
Agli studenti vengono forniti i pdf delle lezioni impartite. Inoltre viene suggerito l’acquisto di uno dei seguenti testi di biologia molecolare:
- MM Cox, Jennifer A. Doudna, MO’Donnel Biologia Molecolare principi e tecniche. Zanichelli
- Watson JD, Baker TA, Bell SP, Gann A. Levine M. Losick Biologia molecolare del gene Sesta edizione Zanichelli.
- Amaldi et al. Biologia Molecolare. Zanichelli

General pathology and immunology

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 10,0

Term or Semester 2° semester

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Goals
The course focuses on the molecular and biotechnological aspects of general pathology and immunology.

**Acquired skill**

Students will acquire basic knowledge of the main molecular and cellular mechanisms representing the pathogenic basis of human pathology. The course includes a focused part on immunology and the role of immunomodulated mechanisms of disease. Students will also acquire information on potentials and limitations of experimental models available. The journal club sessions will allow them to develop critical reading, presentation, and scientific data discussion abilities.

**Program with reference to descriptor 1 and 2**

**General pathology**

- Cellular and tissue responses to stress.
- Processes of cell death: necrosis and apoptosis.
- Degenerative processes of accumulation.
- Biological and physical barriers of innate immunity.
- Origin and function of cells of the innate immunity.
- The endothelium and leukocyte recruitment.
- Mechanisms of pathogen recognition: TLR structure and signalling properties.
- Mechanisms of pathogen killing: phagocytosis and reactive oxygen intermediates.
- Soluble mediators of innate immunity.
- The complement system.
- Chronic inflammation.
- Tissue repair and granulation.
- Fibrosis and sclerosis.
- Pathogenesis and risk factors of atherosclerosis.
- Atherosclerosis: mechanisms of plaque generation and complications.
- The coagulation cascade.
- Pathogenesis and clinical manifestations of bleeding disorders.
- Pathogenesis and clinical manifestations of thrombotic diseases.

**Principles of immunology and immunopathology**

- Features of acquired immune response: specificity, memory, tolerance.
- Primary and secondary lymphoid tissues.
- Antigen-presenting cells.
- Antigen processing and presentation.
- Structure and function of major histocompatibility complex class I and II.
- Intrathymic development: negative and positive selection.
- Generation, structure and signal transduction of the TCR.
- Differentiation, activation and maturation of cytotoxic and helper T lymphocytes.
- Differentiation, activation and maturation of B lymphocytes.
- Generation, structure and signal transduction of the BCR.
- Structure and biological properties of antibodies.
- Failure mechanisms of central and peripheral tolerance.
- Congenital and acquired immunodeficiencies.
- Hypersensitivity reactions (I, II, III and IV type).
- Tolerance and rejection of organ transplants.

**Program Principles of Oncology**

- Classification of tumors.
- Tumor cell biology.
- Cancer and cell cycle deregulation.
- Chemical, physical and viral carcinogens.
- Oncogenes and tumor suppressor genes involved in apoptosis.
- Genes that maintain the integrity of the genome.
- Epigenetic alterations in cancer.
- Telomerase activity and erosion of telomeres.
- Tumor microenvironment: extracellular matrix and angiogenesis.
- Mechanism of invasion and metastasis.
- Immunology of cancer.

**Program's information**

- Patologia generale, Pontieri, Piccin Editore
- Le basi patologiche delle malattie, vol. I., Robbins, Cotran, Piccin Editore
- Immunobiologia, Janeway, Travers, Walport, Shlomchik, Piccin Editore
- Immunologia, infezione, immunità, Pier, Lyczak, Wetzler, Piccin Editore

**Genetics**

**Degrees:**

- D47 - Medical Biotechnology (Classe L-2); total credits 7,0

**Term or Semester** 2° semester

**Prof. RIVA PAOLA VANDA**, Medical Biotechnology and Translational Medicine

**Address:** 02503 15862 - v. Viotti, 3-5 02503 30441 - VIA F.LLI CERVI 93 SEGRATE 02503 30462 - v. F.Lli Cervi, 93 - Segrate

**Email:** paola.riva@unimi.it

**Goals**
The course aims to provide the students with basic knowledge of Mendelian genetics required to understand principles and contents of the most advanced courses in human molecular genetics and medical biotechnology. The student will have to achieve the comprehension of mechanisms at the basis of hereditary traits transmission and to apply the principles, besides to demonstrate a thorough knowledge on molecules and chromosomal structures that constitute the genetic material.

**Acquired skill**
The student will be able to demonstrate to have understood the contents reported in the program to achieve the objectives above described.
The written examination is aimed at evaluating the ability of the student to solving the genetic problems that require the correct application of Mendel's laws to identify a specific modality of inheritance in plant or animal models in in humans, also evaluating the risk of transmission of a given normal or pathological trait. During the oral examination the student will demonstrate to have understand principles and theoretical basis of heredity and to be able to evaluate the effects of allele frequencies on genotype frequencies and on incidence of normal and pathological traits in populations. The student will have to be able to classify DNA mutations and chromosomal variations and to define their effects. The student will have also to describe the practical lab activity and the seminar attended during the course.

**Program with reference to descriptor 1 and 2**

Theoretical and Practical laboratory activities and Seminars:
Frontal activities to apply analytical approaches to solving genetics problems helping a better comprehension of the concepts taught during the frontal lessons.
Practical laboratory activities aimed at providing the student basic competences on a specific diagnostic methodology applied in human genetics
Seminar on applications of genetics in diagnostic or in forensic field

**Program's information**
Russell, iGenetica - Pearson, Snustad-Simmons - EsiSES, Principi di Genetica- EdiSES,

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**Human anatomy and histology**

**Degrees:**
- D47 - Medical Biotechnology (Classe L-2); moduli/unità didattiche: Modulo: Anatomia Umana , Modulo: Istologia total credits 7,0

**Term or Semester** 2° semester

Prof. GAGLIANO NICOLETTA, Biomedical Sciences for Health
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Prof. PROCACCI PATRIZIA, Biomedical Sciences for Health
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Prof. SARTORI PATRIZIA, Biomedical Sciences for Health
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**Goals**
At the end of the course the student should
- to know the methods and morphological survey tools
- learn about the morphology of the cells and tissues of the human organism;
- know the main mechanisms through which is realized the maturation of germ elements, fertilization and development of the human organism;
- be able to observe, describe and identify the different organelles of the eukaryotic cell, the various tissues and their localization within the bodies; know: the organization of the human body, the shape and the seat of the organs of the various systems of the body and the main structural features that are the basis of organ functions

**Acquired skill**
- Acquire the knowledge of the morphology, microscopic and submicroscopic structure of cells and tissues, particularly with regard to those of the human organism; to know gametogenesis.
- Describe the general architecture of the human body and the structure of the organs in relation to their functional role.
- Know the basic use of the optical microscope for the observation of histological samples, prepared according to conventional methods.
- Observe histological preparations, in order to discuss, describe and identify the morphological features of the various tissues and organs; demonstrate that the necessary knowledge for subsequent courses was acquired.

**Module:**

**Program with reference to descriptor 1 and 2**
- Epithelial tissue: structure, ultra structure, and major functions. Classification of Epithelia (simple and stratified) and examples. Relations with the underlying connective tissue. Morphological and functional cell polarity. Apical, lateral and basal domain and its specializations. Epithelial cell
renewal.
• Glands: structure, ultrastructure.
  Exocrine glands: classification criteria. Different mechanisms of secretion. Examples of exocrine glands (based on different classification criteria).
  Endocrine glands: classification criteria, mode of secretion and chemical nature of the secreted hormone. Cytological and histological characters of the main endocrine glands: interstitial cells of the testis and ovary, the islets of Langerhans, pituitary, adrenal cortex, corpus luteum, parathyroid, thyroid.
• Sensory epithelia: general characteristics and examples.
• Connective tissue proper: structure and functions. Extracellular matrix: amorphous substance, proteoglycans and glycoproteins; collagen, reticular and elastic fibers. Connective tissue cells: fibroblasts, macrophages, mast cells, plasma cells, adipose cells, mesenchymal stem cells.
  Loose and dense connective tissue.
  White and brown adipose tissue.
• Cartilage: structure and functions. Hyaline cartilage, elastic cartilage and fibrocartilage.
  Bone formation: intramembranous and endochondral ossification.
• Muscle tissue: structure and functions.
  Skeletal muscle tissue, organization of striated muscle fiber, myofilbrils and myofilaments.
  Neuromuscular junction.
  Cardiac muscle: organization of cardiac muscle fiber.
  Smooth muscle.
• Nerve tissue: structure and functions. The neuron: ultrastructure of the cell body, axon and dendrites. Axonal transport. Different types of neurons.
  Unmyelinated and myelinated nerve fibers. Myelin sheath and myelination process. Synapses.
  Glial cells of the CNS, CNS and microglia.
  Formation of the three germ layers. Longitudinal and side folds. Derivatives of the three germ layers.

Module:

Program with reference to descriptor 1 and 2

Anatomy:
• General anatomy:
  Anatomical position, the anatomical planes and the terms used to describe body movements.
  General organization of the human body (body spaces).
  General structure of the organs.
• Integumentary system:
  Skin: general features and structure.
  Skin appendages: general features.
  Breast gland.
• Locomotor system:
  Bones: structure and classification; osteogenesis; bones of the skull, trunk and limbs.
  Joints: classification and structure; description of the main joints.
  Muscles: general morphology and structure; tendons: morphology and structure; study of the main muscles and muscular groups.
  Walls of the head, throat, thorax, abdomen, and relative body spaces.
  Limbs: general structure.
• Cardiovascular system:
  Heart and blood vessels:
  General structure.
  Heart: morphology, position, structure.
  Pericardium.
  Blood vessel structure.
  Systemic and pulmonary circuits.
  Major arteries and veins.
  General organization of the arteries and veins in the head and neck, in the trunk, in the limbs, and in organs.
  Lymphatic system:
  Lymphatic vessels.
  Lymphoid organs (thymus, spleen, lymph nodes, tonsils): localization and structure.
  Haematopoietic and haemocareteic organs.
• Digestive, respiratory, urinary, reproductive, endocrine systems: general morphology, localization, main anatomical relations, structure and morphofunctional aspects of the organs of the different systems.
  Ultrastructure of lung alveoli, nephron (renal corpuscle and air-blood barrier), liver (hepatocyte, biliary capillary, Disse’s space), lining epithelium of the small intestine (enterocytes and microvilli).
• Nervous system:
  General aspects of the evolution of the neural circuits and their organization.
  Central nervous system:
  Major divisions, external morphological features and internal organization of the grey matter and white matter.
Human molecular genetics

Degrees:
- D47 - Medical Biotechnology (Classe L-2): total credits 6,0

Term or Semester 2° semester

Prof. MAROZZI ANNA, Medical Biotechnology and Translational Medicine
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Prof. FINELLI PALMA, Medical Biotechnology and Translational Medicine
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Email: palma.finelli@unimi.it

Prof. PISTOCCHI ANNA SILVIA, Medical Biotechnology and Translational Medicine
Email: Anna.Pistocchi@unimi.it

Goals
The main objective of the course is to provide advanced information on the genetic basis of human disease and to understand the impact of new knowledge on the genome in the study of human molecular genetics.

Acquired skill
After completing the course, the student will have knowledge on specific issues related to the analysis of the human genome and the molecular basis of genetic diseases. In particular, the student should know: the fundamentals of molecular pathology, the most commonly used techniques in molecular diagnosis of genetic diseases, and the main approaches for the genetic analysis of Mendelian and complex characters.

Program with reference to descriptor 1 and 2

Human genome organization

Autosomal dominant and recessive inheritance. Complications of the patterns of inheritance: genetic heterogeneity, incomplete penetrance, variable expressivity, late onset, anticipation, imprinting and uniparental disomy, somatic and germline mosaicism; mitochondrial inheritance; interpretation of the pedigrees (symbology).

Sex-linked inheritance. X and Y linked genes; chromosome inactivation X; functional mosaicism resulting from the X chromosome inactivation, Determination and sex differentiation.


Mutations and genome instability. Classes and molecular mechanisms of mutations. Genetic polymorphisms. Main types of DNA polymorphisms used as genetic markers (RFLP, microsatellites, SNPs). Molecular pathology: mutation for loss or gain of function in relation to dominance-recessiveness. Submicroscopic structural variants: copy number variants (CNVs) and their pathological effects; unequal crossing over as a mechanism that generates structural variant Repeat instability.

Mechanisms and classification of dynamic mutations: Fragile X Syndrome, Myotonic Dystrophy, Huntington disease, Kennedy Disease.

Molecular pathology. Methods for the identification of point mutations: methods to identify new mutations. Genetic mapping of characters Mendelian and complex traits.

Gene markers, recombination frequency and construction of genetic maps. Linkage analysis and calculation of "lod score". Complex or multifactorial diseases: continuous and discontinuous characters; interaction with the environment; characters with threshold effect.

Concept of heritability. Twins studies. Strategies for the identification of genetic factors involved in complex diseases. Non-parametric linkage analysis, case-control association studies, association studies extended to the whole genome (GWAS). Study of linkage disequilibrium and HapMap project.

Identification and characterization of candidate genes for inherited diseases.

Molecular analysis of the human genome. The Human Genome Project, mapping and genome sequencing. The genetics of hereditary cancers. The tumor suppressor genes and the two-hit mechanism.
Human physiology

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 7,0

Term or Semester 1° semester

Prof. FORMENTI ALESSANDRO, Department of Pathophysiology and Transplantation
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Prof. BRAMBILLA DARIO, Department of Pathophysiology and Transplantation
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Goals
The course of physiology has the aim to provide a comprehensive view of the human body in its operation, presenting the different subcellular and cellular phenomena as causal of the more complex levels of organization and homeostatic regulation. This will enable the student to understand the organic bases of diseases and the rational use of medical interventions aimed at their treatment and prevention.

Acquired skill
The student, learning the principles of Human Physiology, the concepts underlying regulatory systems and homeostasis, and principles of operation of the various specific organs and systems, will acquire an overview of the human body from the molecular to the macroscopic level, in the context of biological evolution. With this knowledge, students will be able to cope with simple problems related to the functions and dysfunctions of the organism using the scientific experimental methods. Then, it will have acquired cultural skills to address the study of diseases as alterations of normal physiological functions, and the search for the correct preventive and curative interventions aimed at restoring the functions themselves.

Program with reference to descriptor 1 and 2
Course of Human Physiology
Muscles. The movement in the non-muscle cells. Skeletal muscle. Smooth muscle
The organism on the whole, integrative functions.

Program's information
Principi di Fisiologia, Zocchi, EdiSES
Fisiologia, Stanfield German, EdiSES

Mathematics

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 6,0

Term or Semester 1° semester

Prof. CERBINO ROBERTO, Medical Biotechnology and Translational Medicine
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Goals
This course is an introduction to some basic facts about real functions, real analysis and linear algebra with applications to finding solutions to linear systems.

Acquired skill
The course is devoted to provide a basic knowledge of the main mathematical tools with specific attention to the concept of mathematical function, of limit, and of differential and integral calculus. Part of the course gives the students the main techniques to solve linear systems in many variables.

Program with reference to descriptor 1 and 2
The course starts with a short recall of some basic facts about set theory (union, intersection, function, injective and surjective function, composition of functions and invertible function). Then we recall some properties of rational and real numbers. The first part of the course deals with real functions. We define the notion of limit, continuity, differentiability and regularity. We will show that Taylor’s theorem provides a very useful tool to compute limits of a fairly regular function. Then we show the classical results concerning the study of the graph of a function (extremal points, asymptotes, convexity). Finally, we will explain the theory of integration according to Riemann and some techniques to extract the primitive function of a given one.
In the second part of the course we will explain some basic notions in linear algebra with particular emphasis on the resolution of linear systems. We will introduce the notion of vector space, linear map, rank, kernel and determinant.

**Program's information**
M. Abate, Matematica e Statistica, McGraw Hill (seconda edizione).
Materiale fornito dal docente durante il corso.

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**Medical pharmacology**

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 10,0

Prof. BIFARI FRANCESCO, Medical Biotechnology and Translational Medicine
Email: Francesco.Bifari@unimi.it

Prof. MARABINI LAURA, Department of Pharmacological and Biomolecular Sciences
Email: laura.marabini@unimi.it

**Goals**
The course is divided into two modules: General Pharmacology and Special Pharmacology and Toxicology.

The General Pharmacology Module has as main objectives:
- the definition and classification of drug targets and the description of various aspects of the pharmacodynamic action of drugs;
- the description of the different biotechnological drugs.

The module of Pharmacology and Toxicology has as main objectives:
- the description of the various aspects of pharmacokinetics: absorption, distribution, metabolism and excretion of drugs;
- the definition of rational use bases of the different drugs in the therapy of the various organ pathologies and apparatus;
- the description of the basic principles of toxicology.

**Acquired skill**
Students will learn how drugs reach their drug targets and how they act on them.

**Program with reference to descriptor 1 and 2**

**GENERAL PHARMACOLOGY**

MEMBRANE RECEPTORS
INTRACELLULAR RECEPTORS
ION CHANNELS AND TRANSPORTERS
DRUG-RECEPTOR INTERACTIONS
PRINCIPLES OF CHEMOTHERAPY
PHARMACOLOGICAL CONTROL OF NEUROTRANSMITTER DISEASE
ENZYMES AS DRUG TARGETS
PHARMACOGENOMICS
FUNDAMENTALS OF DRUG DEVELOPMENT AND REGULATION
ANIMAL MODELS IN PHARMACOLOGICAL BIOTECHNOLOGY

**BODY SYSTEMS PHARMACOLOGY AND TOXICOLOGY**

PHARMACOKINETICS
PRINCIPLES OF AUTONOMIC NERVOUS SYSTEM PHARMACOLOGY
SMOOTH MUSCLE PHARMACOLOGY
CARDIOVASCULAR PHARMACOLOGY
INFLAMMATION AND IMMUNE PHARMACOLOGY
RESPIRATORY PHARMACOLOGY
GASTRO-ENTERIC PHARMACOLOGY
CNS PHARMACOLOGY
ENDOCRINE PHARMACOLOGY
PHARMACOGENETICS
PRINCIPLES OF TOXICOLOGY
CELLULAR AND MOLECULAR MECHANISMS OF TOXICOLOGY
ORGAN AND SYSTEM TOXICOLOGY
MUTAGENESIS AND CANCEROGENESIS
EXPERIMENTAL APPROACH IN TOXICOLOGY
ENVIRONMENTAL TOXICOLOGY
TOXICOGENETICS

**Program's information**

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**Microbiology and medical virology**

Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 6,0

Term or Semester 2° semester
Goals
The main aim of the course in medical microbiology and virology is to provide the basic information relating to the major infectious agents of medical interest to the student. In particular, the course will enable the student to understand the morphological and molecular pathways of transmission and pathogenesis of viruses and bacteria, but also of other infectious agents, such as parasites and fungi.

Acquired skill
After completing the course, the student will have knowledge on specific issues related to the morphology, replication and pathogenesis of the viruses, bacteria and fungi, that are of clinical interest. In particular, the student should know for each microorganism: the structure, the genomic organization, the replication, its interaction with the host, the basis of the prevention/cure of the diseases caused by the microorganism.

Program with reference to descriptor 1 and 2

VIROLOGY
General properties of viruses
Description of the structure and of the main morphological characteristics of viruses
Classification of viruses
Description of the main steps of the viral replicative cycle into the host cells
Description of the mode of transmission of viral infections
Description of the effects of viral replication on host cells
The pathogenic mechanisms of viral infections
The meaning of acute, persistent, chronic and latent viral infection
Properties and pathogenesis of the main viral families of medical interest
The following viral families will be described, focusing mainly on their morphologic features, genomic organization, replicative cycle, interaction with the host and pathogenic mechanisms:
- Picornaviridae
- Flaviviridae, Togaviridae, Coronaviridae
- Orthomixoviridae, Paramixoviridae
- Filoviridae, Arenaviridae, Bunyaviridae, Rhabdoviridae
- Retroviridae
- Polyomaviridae, Papillomaviridae
- Parvoviridae, Adenoviridae
- Herpesviridae
- Main hepatic viruses
- Description of Prions and retroid viruses

BACTERIOLOGY
Bacteria properties:
Description of Bacterial cell morphology, distinguishing between fundamental and accessory structures
Description of the main differences between Gram positive and Gram negative bacteria Gram and Ziehl Nielsen stainin
Description of bacterial cell division and of sporulation process
Description of bacterial growth curve
Description of metabolic processes of bacterial cell (fermentation, aerobic and anaerobic respiration)
Pathogenicity and virulence factors
Horizontal gene transfer processes in bacteria (transformation, transduction and conjugation)

Properties and pathogenesis of the main bacterial groups of medical relevance
The following bacteria groups will be described, focusing mainly on their morphological features, virulence factors, interaction with the host and on pathogenic mechanisms:
- Streptococcus, Staphylococcus
- Bacillus, Clostridium, Listeria, Corynebacterium
- Neisseria, Enterobacteria (Escherichia, Salmonella, Shigella) and Vibrio
- Helicobacter
- Brucella, Bordetella, Haemophilus, Legionella
- Spirochetes, Mycobacteria
- Mycoplama, Rickettsia, Chlamydia

Mycologia and parasitology
Brief description of the main properties of Fungi and Protozoa: structure and morphology, reproduction and transmission, pathogenic mechanisms of the most mycosis and parasitic infections of medical interest.

Program's information
Uno di questi testi a scelta:
- Microbiologia Clinica, Eudes Lanciotti, Casa Editrice Ambrosiana
- Microbiologia Medica, Antonelli, Clementi, Pozzi, Rossolini, Casa Editrice Ambrosiana

Organic chemistry
Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 8.0
Term or Semester 2° semester

Prof. PAGLIARIN ROBERTO, Department of Chemistry
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Goals
The course of Organic Chemistry and Laboratory of Organic Chemistry consists of 52 hours of lectures and 24 hours of laboratory exercises. In the course, all classes of organic compounds are presented, describing their chemico-physical characteristics, the reactivity as well as some preparation method. Knowledge of carbohydrates, amino acids, and nucleotides will be increased. Particular attention is dedicated to stereochemistry, with the recognition of chiral molecules and assessments of their reactivity. All the topics discussed are followed by classroom exercises.

Acquired skill
The main purpose of the course is to enable the student to recognize the class of belonging of every organic molecule and thus to predict its reactivity in the biological field as well. In addition, the course provides the minimum cognitive tools for predicting or explaining supramolecular interactions among organic molecules.

Program with reference to descriptor 1 and 2
Introduction: Orbital hybridization, bond polarity, resonance forms, IUPAC nomenclature of the main classes of organic compounds.
Acid-Base reactions: chemical equilibrium, molecular structure and pH
Configuration at double bonds. Chirality and optical activity. Absolute configuration. Conformational isomers.
Nucleophilic substitution: SN2 and SN1 reactions. Stability of carboxylations. Reaction mechanisms
Addition to double bonds: electrophilic addition of water, hydrogen halides. Hydrogenation.
Aromatic and heterocyclic compounds: benzene, benzene derivatives and main heterocyclic compounds. Resonance and electronic structure.
Electrophilic aromatic substitution. Effects of substituent groups in the electrophilic aromatic substitution. Acidity of phenols.
Amines: Properties as bases. Reactivity as nucleophiles
Lipids: Saturated and unsaturated fatty acids. Triglycerides. Soaps
Nucleic acids: Nucleosides, nucleotides and nucleic acids
Organic Compounds of biological interest: Purines and pyrimidines.

Laboratory experience:
Introduction. Purification, distillation and crystallization techniques.
Separation techniques. Extraction at variable pH
Chromatography. Stationary and mobile phase. Silica gel chromatography: Tlc and column chromatography. Principles and applications
Examples of organic reactions

Program's information
Bruice P. Y. “Elementi di Chimica Organica” ed. Edises
Botta, B. “Chimica Organica Essenziale”, ed-ermes
J. Gorzynski Smith “Fondamenti di Chimica Organica”, Mc- Graw - Hill
McMurry, J. “Fondamenti di Chimica Organica” ed. Zanichelli

Eserciziari
Felix S. Lee, Guida alla soluzione dei problemi da “Introduzione alla Chimica Organica” ed. Edises (4° ediz.)

Physiopathology, introduction in biotechnologies diagnostic and therapy

Degrees:
- D47 - Medical Biotechnology (Classe L-2); moduli/unità didattiche: Modulo: Fisiopatologia medica, Modulo: Principi di diagnostica e terapia biotecnologica total credits 9,0

Term or Semester 1° semester

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Prof. BOLLI NICCOLO'
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Prof. FERRARESSO MARIANO, Department of Clinical Sciences and Community
Address: 02503 20393 - v. Sforza, 35
Goals
The training course has the following aims:
- Comprehension of the main physiological systems and their related pathophysiology
- Comprehension of the principles of diagnostic and therapy in liquids and solids tumors

Acquired skill
The course aims to provide students with the basic knowledge of the major human diseases and the processes that cause them, in order to provide the necessary background for understanding the role of the biotechnology tools employed in diagnostics and therapy of these alterations. To this end, the course is structured in a series of lectures regarding the pathophysiology of the main systems complemented by lectures on the possible biotechnological approaches related to the diagnostics and treatment of the analyzed diseases.

Module:
Program with reference to descriptor 1 and 2
Pathophysiology of the Nervous System:
- Neurodegenerative diseases
  Alzheimer's disease and frontotemporal dementia
  Parkinson's disease
- Motor neuron diseases:
  Amyotrophic lateral sclerosis (ALS)
  Kennedy disease
  Spinal muscular atrophy (SMA)
  Hereditary spastic paraplegia
Pathophysiology of the Cardiovascular System:
The heart as a pump and the valvular heart diseases
The heart rhythm disorders
Heart failure
Ischemic heart disease
The Hypertension
The vascular occlusive disease
The vascular system
Pathophysiology of the Respiratory System:
The acute respiratory failure
The chronic respiratory failure
Pathophysiology of the Endocrine:
Role of biotechnology in the management of endocrine tumors (oncogenes and tumor suppressor);
Premature ovarian failure: menopausal age prediction and tools for fertility preservation;
Pathophysiology of GnRH neuron: molecular diagnostics and fertility biotech drugs;
Sensitivity problems and promiscuity hormonal action
Pathophysiology and clinical surgery of the urinary apparatus: Acute renal failure and chronic
Pathophysiology of the liver: Hepatitis viruses and viral hepatitis
Pathophysiology of the Hematopoietic System:
Hematopoiesis
Anemia
Iron metabolism and related conditions
Thalassemia

Module:
Program with reference to descriptor 1 and 2
Principles of diagnostics and therapy in hematology:
Hematopoiesis and its diagnostics
New methods to study tumor transformation in hematology
Haemostasis and Thrombosis
The hematopoietic stem cell
Myeloproliferative diseases
Lymphoproliferative diseases
Techniques in molecular and cellular biology

Degrees:
- D47 - Medical Biotechnology (Classe L-2); moduli/unità didattiche: Modulo: Metodologie cellulari , Modulo: Metodologie molecolari  total credits 10,0

Term or Semester 1° semester

Prof. BASSI ROSARIA , Medical Biotechnology and Translational Medicine
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Prof. AURELI MASSIMO , Medical Biotechnology and Translational Medicine
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Prof. PISTOCCHI ANNA SILVIA , Medical Biotechnology and Translational Medicine
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Prof. VENTURIN MARCO , Medical Biotechnology and Translational Medicine
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Goals
The main goal of the course is to introduce and familiarize students with the fundamental laboratory techniques providing a basic understanding of the methodologies employed for the analysis of nucleic acids and proteins. The course will focus on DNA, RNA and proteins purification and characterization, in vivo and in vitro (PCR) molecular cloning and DNA sequencing. The course will also cover the major principles of enzymatic assays and basic cell culture techniques, including genetic engineering of animal cells. The teaching on the course is split between formal lectures and tutorials most of which are held in dedicated teaching laboratories. This laboratory-based work will provide hands-on experience with nucleic acid and protein isolation, quantification, and characterization. Laboratory activities will include spectroscopy methods (UV-visible), gel electrophoresis (SDS-PAGE, agarose), basic molecular and cell biology techniques such as recombinant DNA, PCR, restriction enzymes, plasmid DNA, sterile techniques, growing bacteria and animal cells, cloning, protein and enzyme assays. Specific goals of the laboratory work is to provide students with the practical skills needed in the basic techniques used in biochemistry, cell and molecular biology, and to let them acquire the knowledge to correctly analyze the experimental results.

Acquired skill
At the completion of this course, students are expected to have an understanding of the major concepts and theoretical principles of basic techniques used in molecular and cell biology as well as the basic practical skills needed to use the fundamental laboratory methodologies.

Module:
Program with reference to descriptor 1 and 2
Cellular experimental systems: methods in bacterial and animal cell cultures (principles, techniques, and applications).
Cell-based DNA cloning: principles of cell-based molecular cloning, use of restriction endonuclease enzymes, ligation, cloning vectors, transformation, screening of colonies.
Gene knockdown methods in cell systems: gene silencing by small interfering RNA (siRNA), microRNA (miRNA), morpholino oligonucleotides.

Module:
Program with reference to descriptor 1 and 2
Fundamental laboratory techniques: overview and principles of centrifugation, chromatography, electrophoresis and spectrophotometry.
Protein purification: introduction and basic principles; protein quantification methods to determine protein concentration. Analysis of proteins by gel- electrophoresis and blotting.
Methods for determination of enzyme activity; general principles of enzymatic assays.
Extraction, purification and quantification of nucleic acids.
Analysis of nucleic acids by gel-electrophoresis and blotting.
cDNA and genomic libraries, library screening methods.
Molecular cloning using polymerase chain reaction (PCR) technology; principles of the PCR method, optimization, primer design, troubleshooting; cloning of PCR products, types of PCR (Long-Range PCR, RT-PCR, quantitative PCR or 'Real-Time'), applications of PCR.
Analysis of gene expression: Northern blot, RT-PCR, in situ hybridization, reporter genes, promoters, DNA-binding proteins, transcriptome analysis, RNA-Seq.

Program's information
Dai geni ai genomi – Principi e applicazioni della tecnologia del DNA ricombinante
Jeremy W. Dale, Malcom von Schantz and Nick Plant, Copyright © 2013 EdiSES
PRACTICAL SKILLS IN BIOMOLECULAR SCIENCES

Training
Degrees:
- D47 - Medical Biotechnology (Classe L-2); total credits 8.0