

BIOLOGICAL SCIENCE
ACADEMIC YEAR 2007/2008
COURSE CONTENTS

**COMPARATIVE ANATOMY
(ANATOMIA COMPARATA)**
Prof. Vincenzo Caputo

Course syllabus

Systematics and evolution of Vertebrates. Plate tectonics; ecological crisis and mass extinctions; chronology of the geological eras and periods. The binomial system of Linnean classification; nomenclature rules; evolutionary systematics and the significance of hierarchical classifications; definition and examples of taxonomic characters; concepts of homology, analogy, convergence, divergence, adaptive radiation and natural selection. The biological species concept and the mechanisms of reproductive isolation. Classification and evolution of chordates (Urochordata, Cephalochordata and Vertebrata or Craniota); evolutionary affinity with Calcichordata and Emichordata; early phases of vertebrate evolution. Classification and evolution of Agnatha: extinct armoured forms (pteraspids and cephalaspids) and hypotheses about bone origin; the living agnathans (Petromyzontiforms and Myxinoidea). The origin of jaws and paired fins and the aquatic gnathostome radiation; classification of placoderms, acanthodians, cartilaginous and bony fishes. The land "conquest": amphibian radiation; classification and evolution of amphibians ("Labyrinthodontia" and Lissamphibia). The full independence from water: amniote radiation; classification and evolution of reptiles. The air "conquest": from feathered dinosaurs to *Archaeopteryx*; classification and evolution of birds. Mammals and the evolution of endothermy; classification and evolution of mammals and mammal-like reptiles (pelycosaur and therapsids). Classification and evolution of primates and man.

Anatomy. History of Comparative anatomy. An outline of organogeny. Tegumentary system; skeletal system; muscular system; nervous system and sense organs; endocrine system; urogenital system; circulatory system; respiratory system; digestive apparatus.

Practical Sessions. Identification and description of macroscopic and microscopic anatomical preparations.

Course and examination. The course takes place during the first semester of the second year (three-year degree course in Biological Science). The examination is oral.

Aims of the course

At the end of the course the student should have the bases of comparative anatomy of vertebrates and be able to evaluate the phylogenetic relationships among the various classes of vertebrates based on the comparison of body plan in different taxa. Furthermore the student should be able to explain the different morphological specialisations from a functional point of view.

Prerequisites

A basic knowledge of animal cytology and histology, and embryology of chordates is required.

Contents

The aim of the course is to depict a general scenario of the evolutionary radiation of vertebrates through the comparative analysis of body plans and organ systems in the different taxonomic groups, aquatic and terrestrial, of this chordate subphylum. After a concise introduction concerning the history of the Earth and geological chronology, vertebrate evolution is explained, with particular emphasis on some "key phases" in the evolutionary-adaptive route (transitions agnates/gnathostomes, bony fish/amphibians, anamniotes/amniotes, ectotherms/endotherms). The anatomy of the apparatuses is analysed in the light of their morpho-functional adaptation to different habitats in the different vertebrate groups.

Reference texts

- Liem et al., Anatomia comparata dei Vertebrati: una visione funzionale ed evolutiva, EDISES, Napoli, 2002.
- Pough F. H., et al., Zoologia dei Vertebrati, Ambrosiana, Milano, 2001.
- Kardong K. V., Vertebrati. Anatomia comparata, funzione, evoluzione, McGraw-Hill, 2005.
- Hickman C. P., et al., Diversità animale, McGraw-Hill, 2004.

**HUMAN ANATOMY
(ANATOMIA UMANA)**
Prof. Manrico Morroni

Aims of the course

At the end of the course the student should have acquired sufficient knowledge to describe human body organization. Such knowledge is fundamental for understanding the functions of both organs and systems. The student must attend theoretical lectures in order to achieve these results. These lectures will be based on the subjects listed in the syllabus.

Course syllabus

Organization of human body and anatomical nomenclature. Skin and its appendages. Short account of musculoskeletal system. Cardiovascular and lymphatic system. Gastrointestinal tract. Respiratory tract. Urinary system. Male and female reproductive system. Endocrine system. Central nervous system. The student must learn both the macroscopic and microscopic appearance for each organ.

Reference texts

- 1) Ambrosi et al.: *Anatomia dell'uomo*. Edi-Ermes, 2006, Milano.
- 2) Morroni M., Castellucci M.: *Quesiti di autovalutazione di Anatomia Umana per i corsi di laurea triennale*, Stampa Nova s.n.c. Industria Grafica, Iesi, 2003.

BACTERIOLOGY (BATTERIOLOGIA) Prof. Francesca Biavasco

Overview of bacteriology

- Structure, function and assembly of bacterial cell parts
- Bacterial envelope: cell-wall, capsule and other surface polysaccharides
- Flagella and swimming motility. Swarming motility
- Fimbriae: structure, classification and involvement in virulence.

Pathogenicity and virulence. Adhesiveness, internalization in epithelial cells; intracellular pathogens. Main bacterial toxins.

Horizontal gene transfer. Evolutionary and medical significance; conjugative transposons, integrons and genetic cassettes; origin, evolution and spread of antibiotic resistance, pathogenicity islands.

Bacterial phylogenesis, classical and molecular taxonomy, the concept of species in bacteriology, Bergey's manual.

Main groups of bacteria involved in human pathologies: *Enterobacteriaceae*, *Pseudomonadaceae*, Vibrios; *Campylobacter*, *Helicobacter*; Mycobacteria; Staphylococci; Streptococci; Enterococci; Listeriae; Neisseriae; Yersiniae; Brucellae; Haemophyli; Bordetellae; spore-forming aerobes (*Bacillus anthracis* and *Bacillus cereus*); spore-forming anaerobes (*Clostridium tetani*, *Clostridium botulinum*, *Clostridium perfringens*); spirochetes; rickettsiae, chlamydiae, mycoplasmas.

Cultivation, identification and preservation of bacteria.

Quantitative tests of antimicrobial susceptibility: Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal Concentration (MBC).

Reference Texts

Madigan, Martinko, Parker. Brock-Biologia dei microrganismi. Casa Editrice Ambrosiana, 2003.
Prescott, Harley, Klein "Microbiologia", McGraw-Hill, 2006.
Testi di supporto:
La Placa. Principi di Microbiologia Medica. Società Editrice Esculapio, 2005
Jawetz, Melnick, Adelberg's. Microbiologia medica. Piccin, 2003.

APPLIED BIOCHEMISTRY (BIOCHIMICA APPLICATA) Prof. Fabio Tanfani

Aims of the course

The aim of the course in Applied Biochemistry is to give information about the basic experimental techniques usually used in biochemistry laboratories for the preparation, purification and structural/functional characterization of biological molecules and of complex biological systems.

Prerequisites

Basic biochemistry

Course syllabus

PURIFICATION OF BIOMOLECULES. Homogenization of cells and tissues. Principles and applications of centrifugation. Separation, purification, and characterization of lipids, and of soluble and membrane proteins. Fractional precipitation and extraction techniques. Principal methods for obtaining highly purified biomolecules.

ANALYTICAL BIOCHEMISTRY. Model biological membranes. Electrophoresis, isoelectrofocusing, blotting. Optical properties of biomolecules: chromophores, fluorophores, and optical active molecules. Radioisotope techniques. Immunochemical techniques.

Reference texts

- Keith Wilson & John Walzer (Eds.), Principles and Techniques of Practical Biochemistry, Cambridge University Press, 2000.
- Alexander J. Ninfa & David P. Ballou, Metodologie di base per la biochimica e biotecnologia, Zanichelli Editore, Bologna.
- David Sheehan, Physical Biochemistry: principles and applications, John Wiley and sons, LTD.

BIOETHICS (BIOETICA) Prof. Adelino Zanini

Aims of the course

The aim of the course is the discussion of the main ethical aspects related to the different uses of biotechnologies. Particular attention will be paid to the different philosophical and juridical approaches concerning the bioethic dilemma. There will be particular focus on the problems of the relationships between moral responsibility, individuals, bio-technologies, environment and economic growth. Knowing these issues is an essential requirement for making responsible ethic choices.

Course syllabus

Bioethics: an introductory view
Philosophy and techniques
The individual and liberty
Moral choices and juridical systems
Life and death
Embryos, vital organs and other "goods"
Bio-technologies and patents

Reference texts

1. E. Lecalano, *Bioetica*, Laterza, Roma-Bari 1999
2. H. Jonas, *Principio responsabilità*, Einaudi, Torino 1993
3. J. Habermas, *Il futuro della natura umana*, Einaudi, Torino 2002
4. S. Rodotà, *Tecnologie e diritti*, Il Mulino, Bologna 1995

CELL BIOLOGY (BIOLOGIA CELLULARE) Prof. Francesco Regoli

Course syllabus

The Course will include both theoretical and practical lessons. The main topics will include an overview and recent advances on the origin and evolution of cells, their use as experimental models. Techniques for preserving and studying biological material: fresh tissues. Chemical fixation and crio-preservation. Principles and applications of cell cultures. Fluorochromes in cell biology: spectroscopy, spectrofluorimetry and applications. Light, fluorescence and confocal microscopy; immunohistochemistry. Cytometry and flow cytometry. Chemistry of cells. Molecular composition, metabolic energy, and biological catalytic activators. Recent insights on vesicular traffic from synthesis in endoplasmic reticulum to final destination, lysosomes and peroxisomes. Role of subcellular targets in the onset of cellular toxicity. Detoxification pathways.

Apoptosis and necrosis. Efflux membrane pumps and acquired resistance. Technical aspects of cell cultures, stem cells and cloning procedures.

Practical lessons will be carried out on the main laboratory techniques currently used in cell biology investigations.

Aims of the course

The course of Cell Biology is aimed at preparing students on the most recent advances in the study of cell biology, with particular emphasis on current technology available for similar investigations. Students will also be introduced to specific issues of growing interest, including potential applications and risks related to the use of cells as experimental models.

Prerequisites

A good knowledge of general biology is useful for this course.

Contents

The course is based on both theoretical lectures and practical sessions concerning the main biological models, methodological techniques and perspectives in Cell Biology. Particular emphasis will be given to emerging issues related to the development and application of new methods for studying and manipulating cells and cellular material; principles and applications of cell cultures, from stem cells to cloning procedures.

FISHERY BIOLOGY (BIOLOGIA DELLA PESCA) Dr. Giovanni Bombace

The syllabus aims at developing the aspects concerning stock assessment and resource management, with particular reference to the Mediterranean and Adriatic situations.

The syllabus is organised to cover three areas:

1. Marine population dynamics; biology and ecology of the most important commercial species;
 2. Knowledge and description of main fishing gears and their impact on resources and the ecosystem; selectivity aspects;
 3. Stock restoration and protection of coastal marine areas.
- In particular the following points will be explained:

- The fishery system and connected aspects (oceanographical, biological, technological, socio-economic, juridical and administrative)
- The marine environments; demersal and pelagic stock; sedentary and migratory resources etc.
- Stock definition: the stock area; sub-unity of stock; multispecific stock; the fishery grounds; the spawn areas and the nurseries.
- Stock parameters; increasing and decreasing factors; stock in equilibrium; the Russell equation.
- Growth (in size and in weight); the growth rate; von Bertalanffy equation.
- Recruitment; recruitment index; adults/recruits and eggs/recruits ratio; stock curve; age/size classes.
- Natural and fishing mortality; instantaneous rate of fishing mortality; total mortality rate (z). Removals and survivals: The exploitation ratio (F/Z).
- Accessibility, vulnerability and catchability.
- The fishing effort; unity of fishing effort; catch per unity effort (C.P.U.E.). Abundance index.
- Mathematic models for stock assessment; catch/effort global models; Maximum sustainable yield (M.S.Y.).
- Fishery statistics in Italy and in Mediterranean countries.
- Biological samplings; the cohort analysis; Virtual Population Analysis (V.P.A.) etc.
- Overfishing and effects on the demersal stock.
- Direct models for assessing resources. The trawl-survey; the echosurvey; eggs and larvae and statistical methods.
- Biomass fluctuations of small pelagic stock; the anchovy case study in the Mediterranean Sea. Alternation and biological compensation. Yields/recruits ratio.
- Resources management and fishing effort regulation; the preservation of sensitive biotopes, the protected marine areas; artificial reefs and fishing; the resources restoration; national and E.C. laws and rules.
- Description and use of the most important fishing gears; nets selectivity; special fisheries with particular fishing boats.
- Practical identification of the most important Mediterranean fish species and systematic description of families.

- Two seminars will be held: on the Mediterranean and Adriatic Sea.

**DEVELOPMENTAL BIOLOGY
(BIOLOGIA DELLO SVILUPPO)
Prof. Oliana Carnevali**

PROGRAM

Module I

Course introduction
Eggs and sperm: origin and development.
Cleavage and Blastula formation
Gastrulation
Neurulation

Module II

Cellular differentiation
Sex determination
Genetics of axis specification in *Drosophila*

Module III

Apoptosis, apoptosis during embryo development
Hormones as mediator of development: Amphibian and insect metamorphosis,
Mammary gland formation

Laboratories:

Morphological observation of gametes, sea urchin *in vitro* fertilization. Morphological observation of different stage of embryo maturation in: sea urchin, zebrafish and amphibian

Reference texts

Biologia dello sviluppo Gilbert S.F, Terza edizione, Zanichelli
Biologia molecolare della cellula Alberts B. et al. , Zanichelli

**MARINE BIOLOGY
(BIOLOGIA MARINA)
Prof. Roberto Danovaro**

Aims of the course

The aim of the course is to provide all the basic knowledge about marine organisms, interactions between organisms-environment and their functions in the marine environment.
The course provides useful elements for organism identification and a scientific approach applied to marine research.

Course syllabus

Summary of course syllabus: History of Marine Biology, Principal characteristics of marine environments, Adaptation of the organisms to the marine environment and their evolution, Principles of marine ecology, Organisms and community, Marine bacteria and viruses, Life cycles and life histories, Plankton characteristics and communities, Benthos: Meiobenthos and Macrobenthos, Necton.

Reference texts

- Cognetti G., Sarà M., Magazzù G., Biologia Marina, Alderoni, 1999.
- Barnes R.S.K., Hughes R.N., Introduzione all'Ecologia marina, Piccin, 1990.
- Fincham A.A., Biologia marina di base, Zanichelli, 1988.
- Ghirardelli E., La vita nelle acque, UTET, 1981.

**MOLECULAR BIOLOGY
(BIOLOGIA MOLECOLARE)
Prof. Anna La Teana**

Course syllabus

Nucleic acids

Structure and chemical-physical properties. Nucleic acids as genetic material. DNA topology. Structural organization of viral, prokaryotic and eukaryotic genomes.

DNA replication

The Meselson and Sthal experiment. The replication fork and the semidiscontinuous synthesis of DNA. Coordinated synthesis of the leader and lagging strands. DNA polymerases in prokaryotes and eukaryotes. Replication origins. Regulation of replication initiation in prokaryotes and eukaryotes. Replication and cell cycle.

Gene organization in virus, prokaryotes and eukaryotes.

Transcription

Different types of RNA: mRNA, tRNA, rRNA, snRNA, scRNA.

Transcription of prokaryotic genes. RNA polymerase and promoters. Termination and anti-termination.

Transcription of eukaryotic genes. RNA polymerases and promoters. Transcription factors. Enhancers and silencers. Termination.

RNA processing

Processing of rRNA and tRNA.

mRNA maturation and splicing. Self-splicing. Editing.

mRNA translation

tRNA as an adaptor: secondary and tertiary structure. Modified bases.

The genetic code. The aminoacyl-tRNA synthetases and the identity rules.

The ribosome. The different steps of protein synthesis. Initiation, elongation and termination factors in prokaryotes and eukaryotes. The role of rRNA in protein synthesis. Antibiotic and protein synthesis.

Regulation of gene expression in prokaryotes

The operon. Structural genes and regulator genes. Induction and repression: the lac, trp, ara examples. Catabolite repression. Attenuation.

Examples of regulation at the post-transcriptional level.

Regulation of gene expression in eukaryotes

Response elements and DNA binding protein domains. Different models for gene activation. DNA methylation and gene expression. Chromatin structure and transcription.

Experimental procedures

Methods for studying DNA: digestion with restriction enzymes, restriction mapping, cloning vectors, DNA sequencing, PCR, Southern blotting, site-directed mutagenesis.

Promoters analysis: footprinting and band-shift, reporter genes, mutations analysis.

Transcripts analysis: northern blotting, S1 mapping, primer extension.

mRNA purification by oligo-dT and cDNA libraries construction.

Methods for RNA secondary structure determination. Cell-free systems.

Aims of the course

The aim of the course is to allow the students to acquire basic information concerning the relationship between structure and function of nucleic acids and the various cellular processes in which they are involved, through a description of the different experimental procedures which have led to current knowledge.

Prerequisites

A good knowledge of Cytology and Biochemistry is required.

Course description

The subjects of this course are the structure and function of the informational macromolecules. The course will offer a detailed description of the biochemical properties of nucleic acids, of nucleic acid-protein interactions, of protein-protein interactions and of the relations between three-dimensional structure of proteins and nucleic acids and their biological functions in all organisms, viruses, prokaryotes and eukaryotes. Special attention is given to cellular processes such as: DNA duplication, transcription and processing of the different types of RNA, mRNA translation and some of the events involved in the regulation of gene expression. A description of the most widely used experimental approaches will be also presented.

Reference texts

Benjamin Lewin, "Il gene VI", Zanichelli, 1999

**FERMENTATION BIOTECHNOLOGY
(BIOTECNOLOGIA DELLE FERMENTAZIONI)
Prof. Maurizio Ciani**

Course description

The contents of this course concern: microbial metabolism during the fermentation process (fermentation, respiration) and its regulation; production and regulation of microbial metabolites; screening of industrial microbial cultures; fermentation technology, parameters of fermentation and microbial growth; notions on bioreactors (types, control parameters, regulations, etc.); down stream process and product recovery).

Aims of the course

The aim of the course is to give a basic knowledge of microorganisms and their modality of use in fermentation processes

Prerequisites

General microbiology
Biochemistry

Course syllabus

Introduction: General arrangement and sectors of application; microorganisms and products of industrial fermentations.

Microorganisms and fermentation

Taxonomic and systematic arrangement of microorganisms for use or potential use in fermentation processes; microbial metabolism: main pathways of carbon and nitrogen metabolism and their regulations; respiro-fermentative metabolism of yeasts; metabolic regulation; screening and selection of industrial cultures; genetic manipulations of industrial strains; The conservation of the cultures: the collection of microorganisms.

Fermentation technology

Raw materials and the composition of substrate for fermentation. Fermentation processes: batch, extended batch, batch with cell recycle, continuous process; kinetics of microbial growth and fermentation products; principal parameters of the fermentation process.

Bioengineering

Bioreactors: agitation and aeration technology, (oxygen transfer); measurements and regulation of principal fermentation parameters; fermentation plant (fundamental and auxiliary equipment, modality of sterilization, Product recovery

Reference texts

- Scriban R., Biotecnologia, Edagricole, Bologna, 1991.
- Moo Young M, Comprehensive Biotechnology, Pergamon, Oxford, 1985.
- Cavazzoni, V., Manzoni M., Biotecnologia delle fermentazioni", C.U.S.L, Milano, 1993.

**BOTANY
(BOTANICA)
Dr. Cecilia Maria Totti**

Objectives of the course

Aim of this course is to provide students with a basic knowledge plant biology, both in the general and in systematic aspects. The structure and function of cells, tissues and organs of plant organisms will be presented. Finally, the main groups of plant organisms and fungi will be treated in terms of morphological, anatomical and reproductive traits.

Prerequisites

Basic knowledge of physics and general and organic chemistry. It is recommended to pass the course of Cytology and histology.

Course contents

Introduction to botany. Prokaryotes: general characteristics of bacteria. Cyanobacteria: cell structure, morphology and distribution.

Characteristics of eukaryotic plant cells: cell wall, plastids, vacuole.

Protista: general characteristics of main algal groups: Rhodophyta, Dinophyta, Heterokontophyta, Haptophyta, Cryptophyta, Euglenophyta, Chlorophyta.

Fungi: general characteristics and life cycles of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota. Lichenes.

Introduction to Plant Kingdom. Adaptations to terrestrial life.

Non vascular plants: Bryophytes. General characteristics and life cycles of mosses and liverworts.

Introduction to vascular plants.

Pteridophytes: morphology and life cycles of lycopods, equisetata and ferns. Some aspects about phylogeny of Pteridophytes.

Spermatophytes: Gymnosperms (Coniferophyta, Cycadophyta, Ginkgophyta); Angiosperms: (Monocotyledones and Dicotyledones) reproduction and life cycle; flowers, seeds, fruits.

Morphology and anatomy of Spermatophyta. Tissues and organs: meristematic and adult tissues; morphological and anatomical characteristics of roots, stem and leaves. Annual, biannual and perennial plants.

Reference texts

LONGO C., MARZIANI G., 2005. *Biologia delle piante. Forme e funzioni elementari*. Utet.

RAVEN P.H., EVERT R. F., EICHORN S.E., 2002. *Biologia delle piante*, VI ed. Zanichelli.

GEROLA et al., 2002. *Biologia e diversità dei vegetali*. Utet.

MAUSETH J.D., 2003. *Botanica – Biodiversità*. Idelson Gnocchi.

JUDD W.S., CAMPBELL C.S., KELLOG E.A., STEVENS P.F., DONOGHUE M.J., 2002. *Botanica sistematica. Un approccio filogenetico*. Piccin.

MARINE BOTANY (BOTANICA MARINA) Dr. Cecilia Maria Totti

Objectives of the course

Aim of this course is to provide students with a basic knowledge of plant biology, both in the general and in systematic aspects. The structure and function of cells, tissues and organs of plant organisms will be presented. Finally, the main groups of plant organisms and fungi will be treated in terms of morphological, anatomical and reproductive traits. Finally some topics on the biology and ecology of marine plants will be deepened.

Prerequisites

Basic knowledge of physics and general and organic chemistry. It is recommended to pass the course of Cytology and histology.

Course contents

Introduction to botany. Prokaryotes: general characteristics of bacteria. Cyanobacteria: cell structure, morphology and distribution.

Characteristics of eukaryotic plant cells: cell wall, plastids, vacuole.

Protista: general characteristics of main algal groups: Rhodophyta, Dinophyta, Heterokontophyta, Haptophyta, Cryptophyta, Euglenophyta, Chlorophyta.

Fungi: general characteristics and life cycles of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota. Lichenes.

Introduction to Plant Kingdom. Adaptations to terrestrial life.

Non vascular plants: Bryophytes. General characteristics and life cycles of mosses and liverworts.

Introduction to vascular plants.

Pteridophytes: morphology and life cycles of lycopods, equisetata and ferns. Some aspects about phylogeny of Pteridophytes.

Spermatophytes: Gymnosperms (Coniferophyta, Cycadophyta, Ginkgophyta); Angiosperms: (Monocotyledones and Dicotyledones) reproduction and life cycle; flowers, seeds, fruits.

Morphology and anatomy of Spermatophyta. Tissues and organs: meristematic and adult tissues; morphological and anatomical characteristics of roots, stem and leaves. Annual, biannual and perennial plants.

Plant adaptations to the aquatic environment. Marine Angiosperms: general characteristics, morphological anatomical and reproductive adaptations; origin evolution and geographical distribution. Mediterranean seagrasses. Ecological importance of seagrasses. Salt marsh vegetation.

Benthic algae and their distribution. Environmental factors: substrate, light, hydrodynamism, grazing. Epiphytic algae. Microphytobenthos. Periodicity and duration of benthic plants.

Planktonic algae: size subdivision. Adaptations of phytoplankton; succession of phytoplankton populations in temperate, tropical and polar waters. Environmental factors affecting phytoplankton. Algal blooms. Red tides. Eutrophication. Harmful algae.

Reference texts

LONGO C., MARZIANI G., 2005. *Biologia delle piante. Forme e funzioni elementari*. Utet.
RAVEN P.H., EVERT R. F., EICHORN S.E., 2002. *Biologia delle piante*, VI ed. Zanichelli.
GEROLA et al., 2002. *Biologia e diversità dei vegetali*. Utet.
MAUSETH J.D., 2003. *Botanica – Biodiversità*. Idelson Gnocchi.
JUDD W.S., CAMPBELL C.S., KELLOG E.A., STEVENS P.F., DONOGHUE M.J., 2002. *Botanica sistematica. Un approccio filogenetico*. Piccin.
DAWES C.J. 1998. *Marine botany*. 2nd edition. John Wiley & Sons, New York.
GRAHAM L.E., WILCOX L.W., 2000. *Algae*. Prentice Hall.
VAN DEN HOEK C., MANN D.G., JAHNS H.M. Algae. (1995) An Introduction to phycology. Cambridge University Press.

CHEMISTRY I (CHIMICA I) Dr. Elisabetta Giorgini

Aims of the course

The course will give the basic principles of chemistry, with theoretical and applicative lectures. At the end of the course, the student will be able to apply the fundamental principles of chemistry, such as nomenclature, molecular structure, acid and base properties, pH of solution, exchanges of energy, etc.

Prerequisites

Basic knowledge of mathematics and physics

Reference texts

- P. Atkins, L. Jones, PRINCIPI DI CHIMICA, ZANICHELLI.
- J.C. Kotz, P.T. Treichel, CHIMICA, EDISES.
- D.W. Oxtoby, N.H. Nachtrieb, CHIMICA MODERNA, EDISES.
- A. Clerici, S. Morrocchi, ESERCITAZIONI DI CHIMICA, SPIEGEL.
- R. Breschi, A. Massagli, STECHIOMETRIA, PELLEGRINI.
- A. Silvestro, C. Amore, M. Di Dio, CAPIRE LA STECHIOMETRIA, CEDAM.

CHEMISTRY II (CHIMICA II) Prof. Lucedio Greci

Aims of the course

The aim of the course is to provide an understanding of the fundamental mechanisms of organic chemistry, which are at the basis of biological processes and to introduce students to the understanding of the reactivity of the main functional groups present in biological molecules.

Prerequisites

A knowledge of general chemistry is required

Course syllabus

Aliphatic hydrocarbons: alkanes, cycloalkanes, alkenes, alkynes. Conformational and configurational stereochemistry. Aromatic hydrocarbons: benzene, arenes. Functional groups: aliphatic and aromatic halides, alcohols, phenols, quinones and hydroquinones, ethers and thioethers, ketones and aldehydes, carboxylic and dicarboxylic acids and their derivatives: esters, acyl halides, amides, anhydrides. Amines. Diazo and azo compounds. Epoxides. Unsaturated carbonyl-containing compounds. The most important pentatomic and hexatomic heterocycles. The synthesis and the chemistry are described for each class of compounds.

Reference texts

- W.H. Brown, Introduzione alla Chimica Organica, Ed. EdiSES.

- Morrison Boyd, Chimica Organica, Ed. Ambrosiana.
- Mc Murry, Chimica Organica, Ed. Zanichelli.
- Cacchi, Nicotra, Esercizi di Chimica Organica, Ed. Ambrosiana.

**INSTRUMENTAL ANALYTICAL CHEMISTRY
(CHIMICA ANALITICA STRUMENTALE)
Prof. Giuseppe Scarponi**

Formative objectives

Aims. The course enables students to acquire the theoretical and methodological fundamentals, as well as the technical/practical skills of the main techniques of chemical analysis: gravimetric and volumetric methods, and instrumental techniques (potentiometry, conductimetry, UV-Vis spectrophotometry, polarography).

Objectives. At the end the student should have acquired, through theoretical lectures and individual laboratory practical work, the following professional skills: ability to carry out classical and instrumental chemical analyses for employment in analysis and research laboratories.

Prerequisites

Knowledge of the topics of courses on Mathematics, Physics, General and Organic Chemistry.

Programme

General introduction to the analytical process. Accuracy and precision. Traceability. Gravimetric and volumetric methodologies. General equipment of the analytical laboratory. Stoichiometric calculations. Quantification methods in instrumental analysis (calibration curve, standard additions, internal standard). Galvanic cells and electrode potentials: the Nernst equation. Electrodes. Potentiometer. pHmeter. Direct and indirect potentiometry. Electrical conductivity and laws of conductivity. Conductivity cells and conductimeter. Direct and indirect conductimetry. Absorption of the electromagnetic radiation. The Beer law. UV-Vis spectrophotometry. Instrumentation. Direct analysis. Photometric titration. Introduction to polarography and of advanced voltammetric techniques.

Teaching method of the course and assessment method

The course consists of theoretical lectures (7 credits, 63 hours) and laboratory practical work carried out individually (2 credits, 18 hours). The assessment method is an oral examination.

Bibliography

- *Lecture notes*
- D. A. Skoog, D. M. West, F. J. Holler. *Fondamenti di chimica analitica*, EdiSES, Napoli, 1998.
- D. C. Harris. *Chimica analitica quantitativa*, Zanichelli, Bologna, 2005.

**BIOCHEMISTRY
(CHIMICA BIOLOGICA)
Prof. Enrico Bertoli
(Analytical and Industrial Biology courses)**

Aims of the course

The aim of the course is to give knowledge on the molecular and biochemical mechanisms which lie at the basis of vital processes of cells and their metabolic activity.

The students should also be aware of the practical importance of biochemistry in everyday life and in different professional activities.

Course syllabus

Structural and functional organization of living material in procarriots and eucariots

Properties of biomolecules and adaptation to living conditions

Structure and function of proteins

Enzymes: enzyme kinetics, enzyme specificity and allosteric regulation, mechanisms of action of enzymes, coenzymes

Bioenergetics: ATP and high energy compounds, respiratory chain and synthesis of ATP in procarriots and eucariots
Structure and function of biological membranes
Metabolism and its regulation
Sugar metabolism: glycolysis and Krebs cycle, phosphate pentose pathway, biosynthesis and degradation of glycogen, gluconeogenesis
Lipid metabolism: genesis and oxidation of fatty acids, biogenesis and degradation of cholesterol, biogenesis of steroid hormones, biogenesis of triglycerides and glicerophospholipids
Aminoacid metabolism: biosynthesis of aminoacids, degradation of aminoacids and the different excretion routes of nitrogen
Integration and unidirectionality of metabolic pathways
Transduction of biological signals at the membrane level and the molecular basis of the action of hormones

Reference texts

Jeremy M. Berg, John L. Tymoczko, Lubert Stryer **Biochimica**, quinta edizione, Zanichelli

**BIOCHEMISTRY
(CHIMICA BIOLOGICA)
Dr. Andrea Antonino Scirè
(Marine Biology course)**

Formative aims

The target of the course is to give knowledge on the basic molecular and biochemical mechanisms that are fundamental in the vital and metabolic processes of the cells.

Requirements

Basic knowledge of general and organic chemistry.

Contents

Chemical bounds in biological chemistry. Fundamental organic molecules in living systems. Properties of biomolecules and adaptation to living conditions. Structure and function of proteins. Enzymes: basic concepts and kinetics, control strategies. Respiratory proteins of marine organisms: hemocyanine and hemoglobin. Antarctic fishes and role of anti-freeze proteins. Carbohydrates, glycosaminoglycans, oligosaccharides and glycoproteins. Structure and function of structural and reserve lipids. Structure and function of biological membranes. Metabolism and its regulation. Sugar metabolism: glycolysis and Krebs cycle, phosphate pentose pathway, biosynthesis and degradation of glycogen, gluconeogenesis. Bioenergetics: ATP and high energy compounds, respiratory chain and ATP synthesis, molecular oxygen toxic derivatives and protective enzymes. Lipid metabolism: genesis and oxidation of fatty acids, biogenesis of cholesterol, steroid hormones, biogenesis of triglycerides and glicerophospholipids. Proteins turnover and aminoacid catabolism. Transduction of biological signals at the membrane level and the molecular basis of the action of hormones.

Reference books:

J.M. Berg, J.L. Tymoczko e L. Stryer **BIOCHIMICA**, 5ed, Zanichelli.

D.L. NELSON e M.M. COX **INTRODUZIONE ALLA BIOCHIMICA DI LEHNINGER**, 3ed, Zanichelli.

**CHEMISTRY OF BIOACTIVE COMPOUNDS
(Chimica dei composti bioattivi)
Dr. Giovanna Mobbili**

Aims of the course

The aim of the course is to apply organic and general chemistry knowledge to the study of drug-receptor interactions and to the mechanism of action of bioactive molecules.

On completing this course students will have developed an understanding of how molecules interact at the molecular level and how this relates to the activity of drugs and they will have gained a basic understanding of the application of physico-chemical principles to living systems. Students will have further developed skills in the use of reaction mechanisms and how a knowledge of reaction mechanisms can aid in understanding the mode of action of a drug. They will also have developed skills in problem solving through exercises on topics of the course.

Prerequisites

Fundamentals of General Chemistry (CHIMICA I), Organic Chemistry (CHIMICA II), Biochemistry (CHIMICA BIOLOGICA)

Course syllabus

Biopharmaceutical properties of drugs. Physicochemical parameters and drug absorption: solubility, ionisation and pH, lipophilicity, hydrogen bond, electronic properties. **Structure and pharmacological activity.** Optic and geometric isomery, conformational isomery, isosterism and pharmacological activity. **Receptors.** Receptor models and drug-receptor interaction. **Drug metabolism.** Phase I transformations and phase II transformations: conjugation reactions. **Prodrugs.** Prodrug usefulness, kinds of prodrugs, prodrug activation mechanism. **Antibiotics.**

Reference texts

- Edited by F.D.King, Medicinal Chemistry. Principles and Practice. Second Edition, Royal Society of Chemistry, Cambridge, 2002.
- Richard B. Silverman, The Organic Chemistry of Drug Design and Drug Action, Academic Press, 1992.
- Foye, Lemke, Williams, Principi di Chimica Farmaceutica, PICCIN, Padova, 1998.

APPLIED ORGANIC CHEMISTRY (CHIMICA ORGANICA APPLICATA)

Dr. Roberta Galeazzi

Objectives:

Let the students understand the molecular interactions between organic compounds (i.e. drugs) and biological macromolecules. These aspects can be focused both with the aim of computational methods and with laboratory essays.

Contents:

Constituents of nucleic acids: nucleosides and nucleotides. Synthesis of nucleosides: application to the design of modified nucleosides with antiviral or antitumoral activity. Synthesis of ribo- and deoxyribonucleotides both in solution and in solid phase. Antiviral chemotherapy. DNA interaction with UV light.

Covalent interaction of nucleic acids with small molecules; Reaction with metabolically activated carcinogens; Biological consequences of DNA alkylation; Oligonucleotides Antisense: structure and design as antitumoral compounds.

Course Textbooks:

Nucleic Acids in Chemistry and Biology, Eds. G.M.Blackburn, M.J.Gait, Oxford University Press, 1996.

Chemistry of Biomolecules: An introduction., R.J.Simmons, Springer Verlag, 1992.

Top Drugs: Top Synthetic Routes, J. Saunders, Oxford University Press, 2000.

Further readings:

Introduction to Medicinal Chemistry, G.L.Patrick, Oxford University Press, 2005.

CYTOGENETICS (CITOGENETICA)

To be defined

Origins and direction of Cytogenetics

Cell Cycle in the Mammals: Mitosis e Meiosis.

Chromosome organization: Centromeres; Kinetochores and Telomeres

Architecture and Function of the Eukaryotic Chromosome

Constitutive and Facultative Heterochromatin

“Polytene” Chromosomes and “Lumpbrush” Chromosomes

Human Karyotype: characterization of metaphase chromosomes

Banding Techniques. Prophase or High-resolution Banding. Chromosomal Polymorphism

Chromosome Structural Aberrations. Numerically Abnormal Chromosome Constitution

Meiotic Consequences of Inversion and Translocation

Imprinting and Uniparental Disomy

Human sex determination. X and Y Chromosomes. Evolution of Human Chromosomes
Fragile Sites. Mutagenesis studies. Causes of Chromosome Breakage. SCE/MN
In Situ Hybridization. Chromosomes and Cancer. Studies of Prenatal Chromosomes.
Somatic Cell Hybrids in Gene Mapping.

The course takes place during the second semester of the 3rd year (three-year degree course in Biological Science)
The examination is oral.

Reference texts:

Wagner-Maguire-Stallings: *Chromosomes. A Synthesis* (Ed. Wiley-Liss 1993)
T.D. Gelehrter, F.S. Collins, D. Ginsburg: *Genetica Medica* (Ed. Masson 1999)
Peter Sudbery: *Genetica Molecolare Umana* (Zanichelli 2000)
Patricia A. Hoffee: *Genetica Medica Molecolare* (Zanichelli 2000)
Roma Magistrelli: *Corso di Citogenetica* (2005-2006)

**CYTOLOGY AND HISTOLOGY
(CITOLOGIA ED ISTOLOGIA)
Prof. Ettore Olmo**

Course syllabus

Cytology: General properties of living organisms; chemistry of the cells; cellular membranes; cytoskeleton; endoplasmic reticulum; Golgi body; lysosomes; nuclear envelope; chromatin and chromosomes; mitosis; meiosis.

Outline of Embryology: Gametogenesis; reproductive cycle; fertilisation; cleavage; a model of gastrulation.

Histology: Epithelial tissue; connective tissue (blood, connective, cartilage, bone); muscular tissue; nervous tissue.

Aims of the course

The characterising formative activities of the course are the cell and development

Related formative activities of the course deals with animal tissues

-The aim of the course is to allow students to acquire a basic knowledge of the structure and function of the Prokaryotic and Eukaryotic cells; of their differentiations and of the main lines of embryonic development in vertebrates.

Prerequisites

Basic secondary school level knowledge of Physics, General and Organic Chemistry and basic aspects of Botany, Zoology and Human Anatomy.

Course description

The course deals with the study of the composition, morphology, structure and function of the cell, with special reference to the eukaryotic one; the fundamental aspects of the embryonal development of chordates and the study of the morphology and function of animal tissues

Reference texts

- Rosati P. e Colombo R., Vol. 1: La cellula; Vol. 2: I Tessuti, EDI Ermes, Milano, 2001.
- Olmo E., Elementi di Embriologia Comparata, CLUA, Ancona
- Colombo R, Olmo E., Biologia della cellula e dei tessuti, 2 volumi, EDI Ermes, Milano

**ECOPHYSIOLOGY OF AQUATIC PLANT ORGANISMS
(ECOFISIOLOGIA ORGANISMI VEGETALI ACQUATICI)
Prof. Mario Giordano**

Aims of the course

The aim of the course is to allow the student to acquire basic knowledge of the functional aspects of the biology of aquatic photosynthetic organisms at a cell, organismic and autoecological level. Lectures will focus mainly on photosynthesis and related topics. The interactions between aquatic chemistry and physics and the physiology of the photosynthetic organism will be described. At the end of the course, the student, not only will have learned the basics of aquatic photolithotroph ecophysiology, but will also be able to analyze independently and creatively the primary sources of literature and use them to set up scientific

projects. The course will be taught in an interactive way and the student will be required to participate actively

Prerequisites

The student must

- Be familiar with the procedures and resources for literature research
- Be able to read and comprehend scientific literature in English
- Have a thorough knowledge of chemistry, biochemistry and physical-chemistry
- Have a thorough knowledge of plant cytology
- Have a basic knowledge of algae and plant structure and of their phylogenetic relationships

Course syllabus

Evolution of the Earth System

Evolution of photosynthetic organisms
Light in water
Inorganic C in water
Antennae
Reaction centers
Chloroplast electron transport
Inorganic carbon fixation
Photorespiration
CO₂ concentrating mechanisms
Non-photosynthetic carbon metabolism
Main aspects of nitrogen metabolism
Metabolic interactions and regulation

Reference texts

- Buchanan, Grissem e Jones, Biochemica Biologia Molecolare delle Piante, Zanichelli, Bologna, 2004.
- Zeebe, Wolf-Gladrow, CO₂ in Seawater: Equilibrium, Kinetics, Isotopes, Elsevier, 2001.
- Falkowski, Raven, Aquatic Photosynthesis, Blackwell, 1997.
- Kirk, Light and Photosynthesis in Aquatic Ecosystems, Cambridge University Press, 1994.
- Pilon, An introduction to the Chemistry of the sea, Prentice Hall, 1998.
- Skinner, Porter e Botkin, The Blue Planet: An Introduction to Earth System Science, Wiley, 1999.

ECOLOGY (ECOLOGIA) Dr. Antonio Pusceddu

INTRODUCTION- The ecosystem and its properties; the flux of energy within ecosystems; autotrophy and heterotrophy; biomass, production and turnover; thermodynamics of ecosystems; food chains and food webs; microbial loop; food pyramids; ecological efficiency; exergy and energy; hierarchical nature of ecosystems; system ecology and Odum's language.

RELATIONSHIPS BETWEEN ORGANISMS AND THE ENVIRONMENT – Liebig's and Bartholomew's laws; optimal and saturation responses; temperature and organisms; salinity and organisms; pressure and organisms.

RESOURCES – Renewable and non-renewable resources; consumers' growth and the availability of resources; solar radiation; factors limiting primary production; biomass, production and turnover in terrestrial and aquatic ecosystems; organisms as resources; specialists and generalists; trophic state of ecosystems: bottom-up and top-down control mechanisms; food preferences and switching; optimal foraging theory; basis of resources conservations.

POPULATION ECOLOGY – life tables and population age; recruitment; survival curves; populations' growth in non-limited and limited environments; biotic potential; density-dependent factors; effects of density on populations' growth; logistic growth; carrying capacity; r-K strategies; distribution patterns of organisms.

RELATIONSHIPS BETWEEN ORGANISMS – Competition; intraspecific and interspecific competition; Lotka-Volterra models; competition for resources and the Tillman's models; experimental study of competition; predation and functional responses of predators; prey-predators relationships; Lotka-Volterra models; Rosenzweig and McArthur models.

NICHE ECOLOGY AND E SUCCESSIONS – The ecological Niche; the theory of equilibrium; competitive exclusion; species coexistence; the ecological role of disturbance; successions; facilitation theory; climax; bioenergetics of successions: production vs. respiration.

BIODIVERSITY – The significance of biodiversity; the different levels of biodiversity; biodiversity indexes; species-abundance relationships; biodiversity and competition; the biogeographical theory of Islands; biodiversity and predation: the role of key predators.

COMMUNITY ECOLOGY – The role of abiotic factors, competition and predation on species coexistence. Key predators and bottleneck theory; the role of disturbance; dominance-controlled communities; the competitive lottery; supply side ecology; the role of recruitment.

Objectives: The course aims at providing students with the basic knowledge on structure and functioning of ecosystems and of relationships between organisms and the environment. The course includes basics of population dynamics and biotic and abiotic factors that regulate temporal and spatial fluctuations of natural population

Content: The course provides the student with the basic concepts about ecosystems, their structure and functioning, the relationships between organisms and the environments, the use of resources. Additional skills deal with the basic elements for interpreting and modelling the fluctuations in abundance and composition of natural communities, through the concepts of ecological niche, succession and biodiversity.

Text books

- Eugene P. Odum, **ECOLOGIA, un ponte tra scienza e società**, PICCIN, Padova, 2001
- M. Begon, J.L. Harper, C.R. Townsend, **ECOLOGIA, Individui, Popolazioni, Comunità**, Zanichelli, Bologna, 2000
- G. Chelazzi, A. Provini, G. Santini, **Ecologia dagli organismi agli ecosistemi**, Casa Editrice Ambrosiana, Milano, 2004.
- R.R. Ricklefs, **ECOLOGIA**, Zanichelli, Bologna, 1997

ECOTOXICOLOGY (ECOTOSSICOLOGIA) Prof. Francesco Regoli

Course syllabus

The Course of Ecotoxicology is based on both theoretical lectures and practical lessons.

Lectures will cover the following topics:

- Introduction and definition of ecotoxicology, distribution of chemicals in the environment and factors which affect their toxicity. - Toxicity Tests, general procedures, interpretation and applicability of results; examples of most commonly used tests for waters and sediments. - Ecotoxicological approach in the marine environment; biomonitoring, biological resources and impact assessment. - Choice of bioindicator organisms. - Biological effects of chemicals, biomarkers at molecular cellular level with diagnostic and prognostic value. Effect and exposure biomarkers. - Biotransformation and toxicity of aromatic xenobiotics – Detoxification and toxicity of trace metals. – Role of lysosomes in detoxification and in pollutant-mediated pathologies. – Antioxidant defences and oxidative stress induced by pollutants. – Environmental genotoxicity and DNA damage as biomarkers. – Immunotoxicity in invertebrates and fish. – Endocrine disruptors in the marine environment. – Liver pathology and chemical carcinogenesis. – Biological and environmental factors which influence responses of biomarkers, basal levels, species sensitivity, adaptation mechanisms. – Case studies of ecotoxicological lessons students will plan a monitoring program, choosing the most appropriate species and biomarkers. The main methodologies will be presented and measured, including a brief discussion of the results obtained.

Aims of the course

The Course of Ecotoxicology aims to prepare students for the study of environmental pollution, with particular emphasis on the toxicological implications of chemicals on various biotic components.

Prerequisites

A good knowledge of ecology, general and cell biology are important prerequisites for this course.

Course description

The course is based on both theoretical lectures and practical lessons concerning the main chemical contaminants, their environmental distribution and biological effects. Particular emphasis will be given to

bioindicator organisms, molecular and cellular responses to pollutants, use of biomarkers, biological and toxicity tests in research, normative guidelines and environmental impact assessment. Concepts like bioconcentration, bioaccumulation and biomagnification will be clarified through metabolism, detoxification and toxicity effects of pollutants. Development of molecular and cellular biomarkers as predictive and diagnostic tools will be based on the most recent scientific findings related to biotransformation of aromatic xenobiotics, induction and inhibition of enzymatic activities, alterations of cellular structures, genotoxicity and chemical carcinogenesis, endocrine disruptors. Practical examples of monitoring programs will be presented and simulated with the definition of sampling strategy, choice of bioindicator species and the study of chemical analyses and biomarkers.

**INTRODUCTION TO ENVIRONMENTAL ECONOMICS AND LAW
(ELEMENTI DI ECONOMIA E LEGISLAZIONE AMBIENTALE)
Dr. Fabio Petrelli**

ENVIRONMENTAL ECONOMY ELEMENTS

1. Economy and environment
2. Causes of environmental damage
3. Decisional process and environment
4. Economical control of the environment
5. Environmental objectives of the European Union
6. Importance of the environmental policies for the economical management of the enterprises
7. Rules in order to sustainable growth at productive sectors level

ENVIRONMENTAL LEGISLATION ELEMENTS

1. Hierarchy of the sources of the national law and typology of the different normative tools
2. Juridical definition of the of environment and sustainable development concept

The international background

1. Traditional rules and beginning statements
- 2 International conditions and organizations

The community background

1. Organization and functional structure of the European Union
2. Rules of the environmental community policy
3. New tools of the community environmental policy (horizontal tools; financial support mechanisms; information and participation)

ENVIRONMENTAL PROTECTION IN ITALY

General rules

1. constitutional rules
2. Environmental laws: Dlgs n.152, 04.06

Environmental government levels

1. Environmental ministry
2. APAT
3. ARPA
4. Environmental associations

Environmental policy

1. Command and control
2. Economical and financial instruments
3. Environmental information

Environmental impact evaluation

1. UE and VIA
2. Italy and VIA: VAS, VIA, IPPC

Environmental damage

SPECIFIC LAWS

1. Water pollution
2. Air pollution
3. Soil protection
4. Waste laws
5. Acoustic pollution
6. Nuclear pollution
7. Electromagnetic pollution

- 8. Natural protected sites
- 9. Industrial activity and pollution risks
- 10. Other types of pollution (biological, chemical, ...)

Reference texts:

- **Compendio di Diritto dell'Ambiente**, Ed. Giuridiche, 2006.
- **Il Testo Unico Ambiente**, Ed. Giuridiche, 2006.
- Marchello F., Perrini M., Serafini S., **DIRITTO DELL'AMBIENTE**, Ed. Giuridiche, 2002.
- Cordini G., **DIRITTO AMBIENTALE COMPARATO**, Cedam, Padova, 2002.
- Maglia S., **CORSO DI DIRITTO AMBIENTALE**, Ambiente-Salute, 2003.

**INTRODUCTION TO MARKETING
(ELEMENTI DI MARKETING)
Prof. Sergio Silvestrelli**

Aims of the course

The course aims to provide a basic knowledge of firms' marketing and of the main analytical methods and practices of management in the commercial field.

Course syllabus

1. The meaning of marketing for the company and the relationship between firm and environment.
 - 1.1. The orientation of the company in the relation to the environment.
 - 1.2. Economic concepts of market and demand.
 - 1.3. Consumer behaviour and industrial behaviour.
2. Market segmentation and product positioning.
3. The new product development process and innovation factors.
 - 3.1. The concept of new product.
 - 3.2. The role of product innovation in the firm's economy.
 - 3.2. The new product development process.
4. Product and brand policy.
 - 4.1. The product mix.
 - 4.2. The strategies of variation of product mix.
 - 4.3. The product's life cycle.
 - 4.4. Brand policies of industrial and commercial firms.
5. Price policy.
 - 5.1. The aims of price determination.
 - 5.2. Price determination's factors: costs and demand.
6. Structural characteristics of the distribution system.
 - 6.1. Middelmans and channels distribution.
 - 6.2. Retailing.
 - 6.3. Wholesaling.
7. Competition and conflicts in the distribution channels.
 - 7.1. Evolution of the relationship between industry and distribution.
 - 7.2. Industry and retailing conflicts.
 - 4.3. The conflicts between channels distribution.
8. The selection of distribution channels and the management of sales force.
9. Marketing communication policy.

Teaching and assessment methods

The teaching methods consist of frontal lectures, exercises and case discussion in classroom. The final examination consists of a conversation that aims to verify the course contents' knowledge and the propensity to logically link the issues.

Materials

Texts recommended by the teacher.

**ETHOLOGY
(ETOLOGIA)
Dr. Stefania Puce**

Course syllabus

- Animal behaviour in evolutionary perspective.
- Instinct and learned behaviour.
- Evolutional basis of instinct and learned behaviour.
- Genetic basis of behaviour.
- Nervous system and behaviour.
- Historic evolution of behaviour.
- Behavioural ecology.
- Habitat selection strategies
- active selection

- migration
- territoriality.
- Trophic strategies
- diet
- catch methods
- competition.
- Antipredatory strategies
- mimicry
- defence methods.
- Reproduction strategies
- sexual and asexual reproduction
- R and K strategies
- sexual selection
- monogamy and polygamy
- polyandry.
- Social behaviour
- sociality cost and benefit
- altruist behaviour evolution
- eusocial organisms.
- Human ethology.

Reference texts

Alcock, Etologia, un approccio evolutivo. Zanichelli

PHARMACOLOGY (FARMACOLOGIA) Dr. Lamberto Re

Aims of the course

The aim of the course is to provide basic knowledge for the understanding of the complex physiological-functional phenomenon that starts with the interaction between specialized tissues and substances, either exogenous or endogenous.

To this end the phenomena through which an either endogenous or exogenous agent, of chemical or natural derivation, is able to induce a functional variation in the cell and in the organism will be described

The subjects dealt with in this course will be fundamental for integrating those notions already studied in the courses of physiology, anatomy and biochemistry in order to achieve a more thorough preparation which guarantees a more harmonic insertion in the field of the sanitary professions and in the field of pharmacological development.

Syllabus

From chemical synthesis and from extracts of natural origin to marketing. Toxicology, pharmaco dynamics, pharmacokinetics, pre-clinical screening and medical epidemiology post-marketing. Description of the biochemical-enzymatic systems subtended to pharmacological action such as receptors, transduction mechanisms, ionic channels, etc. Methods used for the quantitative and qualitative evaluation of pharmacological action. Characterisation and classification of the receptors, curves of affinity for agonists and antagonists. Endo-cellular receptors and tied up biotechnological potentiality to the expression of the DNA. Pharmacological techniques which test in vitro, curves dose-response, Loose Patch Clamp and Patch Clamp. Neuro-muscular preparation of mouse and cellular assays. The abovementioned techniques will be the subject of practical demonstrations. Calcium-antagonist and local-anaesthetic actions. Receptors of the Autonomous Nervous System. Cholinergic and adrenergic modulation. Nicotinic receptor of the neuromuscular junction and examples of neuromuscular blocking agents. Examples of therapeutic principles addressed to the care of the most important pathologies: Antibiotic, Anti-asthmatics, drugs acting on the CNS.

Reference texts

Molecular biology of the Cell, Zanichelli.

Pratt and Taylor, Pharmacology, Mechanisms of action of the Medicines, Zanichelli.

Clipboard and Dispensation of the Developed Lessons.

PHYSICS

(FISICA)
Prof. Paolo Mariani

Course description

The Physics course is concerned with the study of matter, energy, forces, and their interaction in the world and universe around us. The syllabus places a strong emphasis on basic theory and experiments and covers the broad fundamentals necessary for graduate study in interdisciplinary specialties requiring a strong scientific background (e.g., life science, biology, biophysics, atmospheric and environmental sciences). The course is divided in 56 hours of lectures and 32 hours of practical work, which will be performed in the Student Physics Laboratory of the University. The final evaluation will consist in a written test, in the assessment of the Experimental Report concerning the practical activity performed in the Student Physics Laboratory and in an oral examination.

Aims of the course

The course will provide the student with the necessary competences of the basic physical laws and concepts (both theoretical and experimental) to study and to understand the physical properties of biological matter in the frame of life and environmental sciences.

Prerequisites

Basic mathematical concepts (representation on the Cartesian space, direct and inverse proportion, first and second order equations, simple geometrical functions, elementary trigonometry); knowledge of the experimental method; knowledge of basic concepts in Chemistry (atom, molecule, chemical bond).

Course syllabus

Introduction to Physics. Physical values, measurements, units and standards. Kinematics of material point. Dynamics of material point. Kinematics of rigid body. Dynamics of rigid body. Mechanics of liquids and gases. Surface phenomena in liquids. Basic physics of biological membranes: transport phenomena, diffusion, osmosis, Thermodynamics. Real and ideal gases. Kinetic theory of gases. Work, heat and internal energy. First and second laws of Thermodynamics. Entropy. Gibbs and Helmholtz free energies. Electrostatics. Electrical charge, electric field and electrical potential. Gauss' law. Dielectrics and conductors in electrostatic fields. Condensers. Electric current. Ohm's Laws. Simple circuits. Electric phenomena in biological systems. Static magnetic field. Magnetics. Electromagnetic field, Maxwell's equations, electromagnetic waves.

Reference texts

- Cutnell JD , Johnson KW, FISICA, Zanichelli, Bologna, 1994.
- Giancoli DC, Fisica, principi e applicazioni, Ambrosiana, Milano, 2000.
- Iberini G, Carsughi F, Ciuchi F, Dante S, Fiori F, Mariani P, Ponzi Bossi MG, Fisica, Problemi d'esame svolti", Libreria Scientifica Ragni, Ancona, 1996.

GENERAL PHYSIOLOGY
(FISIOLOGIA GENERALE)
(Marine Biology and Oceanography course)
Prof. Paolo Migani

Course description

The General Physiology course provides the students with basic knowledge on the main organs and apparatuses of animal organisms. Particular emphasis is given to the explanation of these mechanisms in terms of physics and physical chemistry. These mechanisms are usually presented as theoretical models in marine Vertebrates but the application of physics and physicochemical laws is extended to the physiology of animals of different groups. Particular emphasis is also given to the way to get from theory to experimental in physiological studies.

Aims of the course

The aim of the **General Physiology** course is to provide the students with:

- basic knowledge of structure and specific functions of organs and apparatuses in animal organisms (with special reference to marine Vertebrates);
- the notion of the application of physics and physical chemistry in mechanisms of animal organs and apparatuses;
- the understanding of theory and practice of the main research methods in Physiology;

- the orientation towards scientific problems and methods of choice in physiological studies.

Prerequisites

To follow the course of General Physiology, students must have a knowledge of Mathematics, Physics, Chemistry and Comparative Anatomy, at the level of the corresponding courses in the Faculty program. Basic Biochemistry would also be beneficial.

Course syllabus

Overview of aims, theories and methods of General Physiology.

Morphology and functional organization of Central Nervous System and neuromuscular apparatus. Structure and functions of membranes in excitable cells. Membrane electric field and potential. Nervous tissue energetics. Electrochemical potential. Ionic composition of intra and extracellular fluids; the equilibrium potential. Membrane permeability; ion pumps.

The action potential. Electric models of excitable membranes; membrane ionic conductance; voltage-dependent channels. Distance transmission of the action potential.

Sensorial structures and functions. Sensory receptors. Specialized sensory organs in marine Vertebrates and invertebrate animals.

Synapses, electrical and chemical. Synaptic transmitters and synaptic membrane receptors. Excitatory and inhibitory post-synaptic potentials. Integrative functioning of nervous circuits.

Skeletal and smooth muscles: features and functions. The role of skeletal muscles in movements and posture. Skeletal muscle structure: biochemistry and the constituents of the functional unit (sarcomere). The neuromuscular synapse and nervous command. Excitation-contraction coupling. The molecular model of contraction. Nature and role of the viscoelastic components in contraction. Swimming, locomotion and standing in Vertebrates.

The circulatory apparatus: morphology and functional features in Vertebrates and invertebrate animals. Functions of cardiac contractile tissues. Mechanics and electric events of the cardiac cycle. Blood vessel structure at micro and macroscopic level; circulatory physics and hemodynamics. Regulation in hemodynamics: functional variations and their automatic regulation. External regulation, the Autonomic Nervous System and the integrated cardiovascular reflexes.

The respiratory apparatus: morphology and functions in Vertebrates and invertebrate animals. Mechanics in pulmonate systems (lungs, airways and thoracic cage): the respiratory cycle, its automatic control and its chemical regulation.

Gas exchanges in gill, alveoli and in tissues. Physical chemistry of gas exchanges through epithelia. Blood transport of respiratory gases. Structure and functions of haemoglobins and other oxygen-carrying molecules.

The renal apparatus: morphology and functions in Vertebrates and invertebrate animals. Physics of the glomerular filtration; the physiological relevance of the renal clearance of blood substances.

The tubular reabsorption. Outline of the transport of solutes in cells; membrane carriers. Water obligatory and facultative reabsorption.

The pH in body fluids. Buffer systems in extra and intracellular fluids. Physiological and pathological pH changes and their renal regulation.

Reference texts

C. Casella V. Taglietti, **Principi di Fisiologia – Volume I e II**, La Goliardica Pavese
D.U. Siverthorn, **Fisiologia. Un approccio integrato**. Casa Editrice Ambrosiana.

**GENERAL PHYSIOLOGY
(FISIOLOGIA GENERALE)
(Analytical and Industrial Biology courses)
Prof. Paolo Migani**

Course description

The General Physiology course provides the students with basic knowledge on the main organs and apparatuses of animal organisms. Particular emphasis is given to the explanation of these mechanisms in terms of physics and physical chemistry. These mechanisms are usually presented as theoretical models in vertebrates but the application of physics and physicochemical laws is extended to the physiology of animals of different groups. Particular emphasis is also given to the shift from theory to an experimental approach in physiological studies.

Aims of the course

The aim of the **General Physiology** course is to provide the students with:
basic knowledge of structure and specific functions of organs and apparatuses in animal organisms (with special reference to Vertebrates);
the notion of the application of physics and physical chemistry in mechanisms of animal organs and apparatuses;
an understanding of theory and practice of the main research methods in Physiology;
orientation towards scientific problems in Physiology and the methods of choice in physiological studies.

Prerequisites

To follow the course of General Physiology, students must have a knowledge of Mathematics, Physics, Chemistry and Comparative Anatomy, at the level of the corresponding courses in the Faculty program. Knowledge of basic Biochemistry would also be beneficial.

Course syllabus

Overview of aims, theories and methods of General Physiology.

Morphology and functional organization of Central Nervous System and neuromuscular apparatus. Reflex arc.

Structure and functions of membranes in excitable cells. Membrane electric field and potential. Nervous tissue energetics. Measurements of brain glucose consumption and blood flow.

Electrochemical potential. Ionic composition of intra and extracellular fluids; Nernst's equation and the equilibrium potential. Membrane permeability; electrogenic and non-electrogenic ion pumps. Goldman's equation.

The action potential: observations and hypotheses. Electric models of excitable membranes; spatial and temporal parameters for signal transmission in electric cables. Membrane ionic conductance; voltage clamp experiments and voltage-dependent channels; the Hodgkin-Huxley (HH) model of the action potential. Distance transmission of the action potential by myelin and non-myelin fibres.

The sensory structures and functions. Sensory receptors. The receptor potential and its relation with stimulus intensity. Receptor transduction: the intensity-amplitude-frequency curves and their adaptation.

Synapses: morphology and functions. Electrical synapses. Chemical synapses. Synaptic transmitters. Synaptic membrane receptors and their coupling with ion channels and intracellular transduction systems. Excitatory and inhibitory post-synaptic potentials (EPSP, IPSP); synaptic integration. Pharmacology and synaptic transmission.

Skeletal and smooth muscles: features and functions. The role of skeletal muscles in movements and posture. Skeletal muscle structure: biochemistry and the constituents of the functional unit (sarcomere). The neuromuscular synapse and nervous command. Excitation-contraction coupling. The Huxley model for contraction at molecular level. Nature and role of the viscoelastic components in contraction. Vertebrate posture; the automatic regulation of standing in bipeds.

The Vertebrate circulatory apparatus: morphology and functional features. Functions of myocardium and conduction tissue. Blood vessel structure at the microscopic and macroscopic level, with references to blood circulation. Mechanics of the cardiac cycle. Electric events of the cardiac cycle and electrocardiography.

Circulatory physics and hemodynamics. Regulation in hemodynamic parameters: physiology and pathology. Intrinsic regulation, the Starling experiment; external regulation, the Autonomic Nervous System and integrated cardiovascular reflexes.

The Vertebrate respiratory apparatus: morphology and functions. Mechanics in lungs, airways and thoracic cage.

Mechanics of the respiratory cycle. Respiratory muscles and their nervous command. The automatic cycle control and its chemical regulation. Pressure-volume diagrams, lung compliance and respiratory work.

Gas exchanges in alveoli and in tissues. Gas composition and pressure changes in atmospheric and alveolar air. Physical chemistry of gas exchanges through epithelia.

Blood transport of respiratory gases. Structure and functions of the haemoglobins and myoglobin. The haemoglobins saturation curve: functional changes and the Bohr effect.

The Vertebrate renal apparatus: morphology and functions. Physics of glomerular filtration; measurement and physiological relevance of the renal clearance of blood substances.

The tubular reabsorption. Outline of the transport of solutes in cells; membrane carriers. Structure and functions of Henle's loop, the counter-current multiply mechanism. Water obligatory and facultative reabsorption.

The pH in body fluids. Buffer systems in extra and intracellular fluids. Physiological and pathological pH changes and their renal regulation.

Reference texts

C. Casella V. Taglietti, Principi di Fisiologia – Volume I e II, La Goliardica Pavese

PLANT PHYSIOLOGY (FISIOLOGIA VEGETALE) Prof. Aurelio De Santis

Aims of the Course

This course will provide the student with a theoretical and working knowledge of molecular processes and functions (at cellular and whole plant level) of importance for higher plant growth and development in agriculture and food production and processing.

Prerequisites

Physics, Botany and Biochemistry

Course syllabus

Transport physiology: Chemical and water potential, Nernst potential; molecular physiology of water and mineral nutrient acquisition, transport and utilization; transport of the products of photosynthesis within the plant body. Respiration and photosynthesis: plant respiratory chain, alternative oxidase and their functions; photosystems, photosynthetic electron chains, photorespiration, C3, C4 and CAM photosynthesis, sucrose and amino acid production in leaves, ROS production in respiration and photosynthesis and defence mechanisms. Plant development: photomorphogenesis and induction of flowering; tropisms; senescence and programmed cell death. Signal perception and transduction: hormones; Ca²⁺ signalling. Responses to abiotic stresses such as drought, salt and cold.

Reference texts

L. TAIZ, E. ZEIGER Plant Physiology, Sinauers Associates, Inc. Pub.

F.B. SALISBURY, C.W. ROSS Plant Physiology, Wadsworth Publishing Company.

B. BUCHANAN, W. GRUISSEM, W. and R. JONES Biochemistry and Molecular Biology of Plants, Wiley, N.Y.

GENETICS (GENETICA) Prof. Davide Bizzaro

Aims of the course

The course is intended to provide a coherent view of modern genetics from mendelian classical genetics up to the evolutionary genetics.

Prerequisites

A good knowledge of Cytology and Histology, Zoology, General Chemistry, Basic informatics and Statistical analysis is required.

Contents

Introduction: the cell cycle: mitosis and meiosis; the sexual reproduction and the variability. Genotype and phenotype: the mendelian genetics. The chromosomal bases of heredity, the determination of sex and sex linked characters in eukaryotic systems. Extension of the mendelian genetic analysis: multiple alleles, variability of the relations of dominance, gene interactions and modified mendelian ratios, genes and environment. Linkage, meiotic and mitotic crossing-over, gene mapping in eukaryotes. Primers of Quantitative genetics. Genetic analysis in prokaryotes: bacterial transformation and transduction. The structure of the genetic material: DNA and RNA. DNA, chromosomes, genomes. Complexity of the

eukaryotic sequences. DNA replication and recombination. Transcription and RNA maturation. Different types of RNA: mRNA, tRNA, rRNA, snRNA,. The translation process, the structure of proteins and the genetic code.

Gene cloning and the technology of recombinant DNA: the restriction enzymes, cloning vectors, genomic banks and gene libraries, synthesis of cDNA molecules. DNA sequencing, the technique of polymerase chain reaction (PCR) ecc.

Gene regulation in bacteria: the Lac and Trp operons in E.coli. Gene regulation in Eukaryotes at different levels: transcription, maturation and translation of mRNAs. Gene regulation in development and differentiation. Imprinting, gene amplification and mechanisms of gene rearrangement. Genetic mutations: point mutation, chromosomal and genomic mutations. Dna repair. Mutagenesis test. The jumping sequences of DNA: the transposons.

The evolutionary genetics (genetics of populations), allelic frequencies, the Hardy-Weinberg equation. The genetic variability in natural populations. The causes of variation of the allelic frequencies in natural populations: natural selection, mutation, random genetic drift, migration. Sickle cell anaemia and thalassemia. Molecular evolution.

Practical work:

- Principles of Bioinformatics.

- Gene polymorphisms determination of some human DNA repair genes: from DNA extraction to PCR and gel fragments analysis of gene polymorphisms.

Reference texts

L. H. HARTWELL et al., Genetica - dall'analisi formale alla genomica. Mc Graw-Hill 2004

P. J. RUSSEL, iGenetica 1ª edizione. Edises, 2002.

R. J. BROOKER, Genetica. Analisi e principi. Zanichelli, 2000

D. P. SNUSTAD, M. J. SIMMONS. Principi di Genetica. Edises, 2004

A. J. GRIFFITHS ET AL., Genetica. Principi di analisi formale. Zanichelli, 2002

MARINE GEOLOGY (GEOLOGIA MARINA) Prof. Massimo Sarti

GENERAL GEOLOGY

- Interior of the Earth. Crust, mantle, nucleus, Mohorovicic discontinuity. Lithosphere and asthenosphere. Distribution of earthquakes. Lithospheric plates
- Gravity and isostasy. Heat flow on oceanic and continental crusts. Convection in the mantle.
- Continental drift, historical evolution of the concept: geologic, palaeontological and geophysical evidences. Earth magnetic field and palaeo-magnetism. Apparent polar wander paths. Magnetic anomalies in the oceanic crust. Magnetic reversals.
- Mid-oceanic ridges, heat flow at Mid-Oceanic Ridges. Fracture zones. Sea-floor spreading and its geologic evidences. Transform faults. Age and thickness of oceanic sediments.
- Plate tectonics and plate margins. Plate kinematics. Relative motion of lithospheric plates on a sphere. Eulerian geometry. Rotation poles. Triple junctions: stable and unstable. Plate of Benioff. Curve of Sclater. Hot spots. A-seismic ridges. Arc-trench systems.
- Ophiolites and mélanges
- Cratons, shields and platforms. Geosynclines: Hall, Dana, Haug, Stille, Kay, Aubouin. Flysch and Molasse. Turbidity currents and turbidites. Aulacogens. Collision orogens (Alps and Himalayas) and activation orogens (Andes). Suspect terrains.

GEOLOGY OF CONTINENTAL MARGINS

- Definition of continental margins. Continental-margin types. Evolution of passive continental margins. Pre-breakup period (phase of uplift and rifting). Breakup unconformity. Post-breakup period (drifting stage)

SEDIMENTATION AND STRATIGRAPHY

- The three basic properties of sediments and sedimentary rocks: composition, texture and structures. Classification of sediments and sedimentary rocks. Diagenesis: lithification and cementation. Textural components. Mineralogical composition. Provenance. Textural and compositional maturity. Conglomerates and breccias. Arenites and their classification. Pelites.
- Limestones and dolomites. Mineralogical composition. Textural elements (skeletal grains, detrital grains, peloids, botryoids, ooids, etc.). Carbonate depositional environments.

- Pelagic sedimentation. Terrigenous and organogenic sedimentation. Concept of biogenic productivity. Production and preservation of biogenic sediment components. ACD and CCD. Dissolution levels. General concepts of physical and chemical oceanography. Oceanic circulation. Anoxic sediments. Chemical composition of marine waters (dissolved salts, nutrient, oxygen). Physical characteristics of marine waters.
- Biogenic pelagic sediments. Biogenic oozes. Siliceous and phosphatic sediments and rocks. Metalliferous sediments. Authigenic components.
- Eustatic variations of the sea level. Eustatic curves. Subsidence mechanisms. Transgressions and regressions and their control factors.
- Stratal relationships among lithosomes. Vertical and horizontal stratal relationships. Unconformities. Lateral stratal relationships and epeirogeny. Concept of facies. Principle of Walther and its applications.

Recommended textbooks:

1. Kennet, J. - Marine Geology. Prentice Hall
2. Anderson, R. N. - Marine Geology. A planet-Earth perspective. Wiley.
3. Seibold, E., Berger W.H. - The sea floor. Springer
4. Bosellini, A.- Tettonica delle placche e geologia. Bovolenta
5. Bosellini, A., Mutti, E., Ricci Lucchi, F. - Rocce e successioni sedimentarie. UTET.
6. Bathurst, R. - Carbonate sediments and their diagenesis. Elsevier.
7. Kearey, P. e Vine, F. J. - Tettonica globale. Zanichelli.

**GENERAL COMPUTER SCIENCE AND STATISTICS
(INFORMATICA E STATISTICA GENERALE)
Prof. Piero Montecchiari**

The scope of the course is to introduce the students to the basic elements of the statistics and the computer programming.

Prerequisites: Basic elements of differential and Integral Calculus.

Program

Informatics: Computer architecture: Hardware, Software, Firmware. Information coding. Positional notation. Bynary, octal and hexadecimal numbers. Base conversion. Algebraic operations. Negative number and sign-magnitud, one's and two's complement representations. Floating point. The ASCII code. Image and sound coding. Parity control. Elements of Boolean logic. Logical operators and expressions. Boolean functions, Karnaugh maps and simplification of logical expressions. Gates and logical circuits. The full adder. Localizing and storing data. Programming languages. Machine language, Assembler and high-level languages. Variable, constants and operators. Control structure: sequential, selection and repetition structures. Algorithms. Introduction to the Pascal language.

Statistics: populations, characters and related typologies; modal class, median; mean, variance, standard deviation for a real variable; multivariate distributions, covariance; linear regression and least squares method; variance and distance; correlation coefficient and matrix. Elements of combinatorial calculus. Aleatory events. Probability space. Conditional probability. Independent events. Bayes Formula. Aleatory Variables. Probability distributions. Moments. Tchebicheff inequality. The Binomial, Poisson and Gauss Distributions. Introduction to Bayesian inference. Likelihood function. Parameter estimates.

Laboratory: Use of a spreadsheet with application to the descriptive analysis of a statistical population of data.

Textbooks:

Tosoratti, **Introduzione all'Informatica**, Ambrosiana,

P. Baldi **Introduzione alla probabilità. Con elementi di statistica**, Mc Graw-Hill Editore

G. Prodi, **Metodi matematici e statistici**, Mc Graw-Hill Editore

**BIOORGANIC CHEMISTRY LABORATORY
(LABORATORIO DI BIOORGANICA)
Prof. Mario Orena**

Aims of the course

The central role of chirality in biological systems is well understood and this topic will be the first target of the course and each stereoselective reaction will be directed towards a biologically active compound. The

second part of the course involves peptide synthesis with particular focus on peptides considered as chiral compounds. Following this approach, the principles of both enzymatic activity and recognition will be easily understood.

Prerequisites

Coverage of specific synthetic reactions including, but not limited to, conformational analysis, oxidations, reductions, aldol and alkylation reactions, and their stereochemical issues.

The subsequent focus of this course is on understanding and using the processes by which peptides are obtained, in order to design new bioactive peptides.

Course syllabus

Part I: The selection in organic reactions

Regio and stereoselection. Stereochemical and conformational descriptors. Miscellaneous methods for the control of stereochemistry. Stereocontrolled electrophilic additions; stereocontrolled nucleophilic additions. The anchimeric effect. Stereocontrol in aldol reactions. Stereocontrol in enzymatic reactions. Stereocontrol by double asymmetric induction. Stereocontrol in chemical and chemo-enzymatic synthesis of bioactive compounds.

Part II: The chemistry of amino acids and oligopeptides

Chiral considerations - Mechanisms of stereomutation; asymmetric induction; factors determining stereomutation; models for studying epimerization; kinetic resolution of amino acid derivatives.

Protection/Deprotection - Alcohol-based protecting groups; mechanisms of deprotection; carbocation formation; preparation of derivatives; photolabile protecting groups.

Sequence Assignment - Identification of N- and/or C-terminus. Edman degradation.

Principles of Peptide Synthesis - Amino acids: ionization and pKa's; temporary protection, orthogonality. Peptide-bond formation; oxazolone formation; urethane-type protectors. Strategies to avoid epimerisation.

Coupling Methods/Activation - Activated forms: for N-protected amino acids; for protected peptide segments.

Solid Phase Peptide Synthesis - Fundamentals; orthogonal systems; polymeric supports; loading of first residue; sensitized/stabilized linkers; Boc vs. Fmoc-chemistry; coupling methods. Isomerization during SPPS; suppression of epimerization; preparation of cyclic peptides.

Side-Chain Reactivity, Protection, and Side Reactions - Factors affecting reactivity and stability; minimum/maximum protection strategies; individual functional groups; aspartimide formation and suppression; dioxopiperazine formation; disulfide interchange; selective derivatization.

Reference texts

- Jones, J., Amino Acid and Peptide Synthesis, Oxford Science Publications, 1997.
- Boger, D.L., Modern Organic Synthesis, Lecture Notes, TSRI Press, 1999.
- Peptide and Peptidomimetic Synthesis - Reagents for Drug Discovery, Fluka Chemie GmbH, Buchs, 2000.
- D'ISCHIA, M., LA CHIMICA ORGANICA IN LABORATORIO, PICCIN, 2004.

MATHEMATICS (MATEMATICA)

Prof. Piero Montecchiari

Aims of the course

The aim of the course is to introduce the students to the basic elements of Differential and Integral Calculus

Prerequisites

Basic Elements of Calculus and Analytic Geometry

Course syllabus

Sets, Relations and Functions. Composition, invertibility. Natural, Integer, Rational and Real numbers. The Induction principle. Supremum, infimum, maximum, minimum. Modulus and powers. Exponential, logarithmic and angular functions. Limit of real sequence and its properties. Indeterminate forms. Monotone sequences. Neper's number and related limits. Asymptotic comparison. Limits of real function of real variable. Properties. Indeterminate forms. Monotone functions. Asymptotic comparison. Continuity; Weierstrass's and Intermediate Values Theorems. Derivative and Derivative Formulas. Successive Derivative. Fermat's, Rolle's, Lagrange's and Cauchy's Theorems. Derivative and monotonicity. Convexity. Primitives. De L'Hospital's Theorems. Asymptotes and the study of the graphs of functions. Definite Integral and its properties. Fundamental Theorem and Formula of the Integral Calculus. Indefinite Integral and integration

methods: sum decomposition, by parts and substitution. General Integral for first order linear ordinary differential equations. The Cauchy Problem. Bernoulli's equations. The Malthus and Verhulst models for population dynamics.

Reference texts

- P. Marcellini - C. Sbordone, Elementi di Calcolo, Liguori Editore, 2004.

GENERAL MICROBIOLOGY (MICROBIOLOGIA GENERALE) Prof. Francesca Biavasco

The Microbial World. Diversity and history of microorganisms. The three-domain view of life. Prokaryotes, eukaryotes, viruses.

The prokaryotes. Bacteria and Archaea.

Structure and function of prokaryotic cells. The cell surface of bacteria: Gram-positive and Gram-negative bacterial cell wall, Peptidoglycan structure and biosynthesis. Surface polysaccharides, flagella, fimbriae. The cell surface of Archaea.

The cytoplasmic membrane and the cytoplasm. The endospore: structure, sporulation and germination.

Mechanics of flagella-mediated motility, chemotaxis; other types of motility. Bacterial genetics: bacterial DNA replication; mobile genetic elements (plasmids, insertion sequences, transposons). Horizontal gene transfer among bacteria: transformation, transduction and conjugation.

The eukaryotic microbes. General features, reproduction and classification of protozoa and fungi. Biological cycles of the main parasites that are pathogenic to humans

The viruses. General features. Viruses of mammalian cells: structure and classification; steps of viral replication. Effects on host cells. Viral persistence, latency and cellular transformation.

Bacteriophages. Virulent and lysogenic bacteriophages: phage T4 and phage lambda replication; lysogenic conversion.

Microbial nutrition and growth. Metabolic types : aerobic, anaerobic, fermentation, photosynthesis; breakdown of polymers and transport across the cytoplasmic membrane. Interactions of prokaryotes with their environment.

Study and cultivation of microorganisms. Methods to microscopy and staining. Cultivation of microorganisms: selection of medium and atmosphere; pure cultures; measurement of growth, the growth curve. Methods of virus cultivation.

Control of microbial growth. Disinfection and sterilization. Antibiotics: general features, mechanisms of action and resistance. Antiviral and antiprotozoan agents. Antimicrobial susceptibility testing: antibiogram.

Microbial ecology and microorganism-host interactions. Microbial communities. Symbiotic interactions: commensalism, mutualism, parasitism. Pathogenicity and virulence: adhesiveness, invasiveness and toxin production. Endotoxins and exotoxins. Nonspecific and specific human body defenses. Immune response, antigens and antibodies, cells involved in the immune response, vaccines.

Basic environmental, food and industrial microbiology.

Testi consigliati:

Madigan, Martinko, Parker. Brock-Biologia dei microrganismi. Casa Editrice Ambrosiana, 2003.

Prescott, Harley, Klein "Microbiologia", McGraw-Hill 2006.

Salyers, Whitt. "Microbiologia". Zanichelli, 2002.

Boyd "Microbiologia generale" (2^a ed. italiana), Medical Books, 1992.

Davis, Dulbecco, Eisen, Ginsberg "Microbiologia"(4^a ed.), Zanichelli, 1993.

Stanier, Ingraham, Wheelis, Painter "Il mondo dei microrganismi"(2^a ed. italiana), Zanichelli, 1992.

Salyers, Whitt. "Microbiology: diversity, disease, and the environment". Fitzgerald Science Press, 2001.

OCEANOGRAPHIC MEASUREMENTS (MISURE OCEANOGRAFICHE) Dr. Aniello Russo

Aims of the course

By the end of the course, the student must know the basic methods and instruments for performing oceanographic measurements and for analyzing the collected data in a correct way.

Prerequisites

No prerequisites; however at least a basic knowledge of physics and mathematics is recommended.

Course syllabus

Measurement errors, precision, accuracy, resolution. Different measurement platforms. Measurement planning and performing.

Main measurement methods. Instruments for Eulerian measurements: thermometers; CTD and XBT probes; mechanic, electromagnetic, acoustic and Doppler currentmeters; Acoustic Doppler Current Profiler; tide and pressure gauges; wave-recorders. Instruments for Lagrangian measurements: surface drifters, neutrally buoyant profilers.

New measurements systems: towed vehicles, Autonomous Underwater Vehicles, gliders. Instruments and methods for surface remote sensing of: temperature, salinity, current, pigments, turbidity, free surface height, waves.

Acquisition, treatment and analysis of oceanographic data.

Reference texts

- W.J. Emery, R.E. Thomson , Analysis methods in physical oceanography, Pergamon.

**NEUROCHEMISTRY
(NEUROCHIMICA)
To be defined**

**OCEANOGRAPHY
(OCEANOGRAFIA)
Dr. Aniello Russo**

Aims of the course

By the end of the course, the student must know the basic mechanisms of physical oceanography which control circulation and the main physical properties of the sea, and be able to describe the main characteristics of the oceans, of the Mediterranean Sea and of the Adriatic Sea.

Prerequisites

No prerequisites; however at least a basic knowledge of physics and mathematics is recommended.

Course syllabus**Basic concepts.**

Main characteristics of oceans and water. Fundamental oceanographic parameters. Oceanographic instruments. Graphical representations of oceanographic data.

Fundamentals of marine dynamics.

Currents without friction. Inertial currents. Geostrophic currents, dynamic height. Atmosphere-ocean coupling. Currents with friction and wind-driven circulation. Upwelling and downwelling. Thermohaline circulation. Deep and intermediate water formation. Waves and tides.

Descriptive oceanography.

Heat, mass and water budgets. Examples of volume and salt conservation. Water types and masses. General characteristics of circulation and water masses in the Oceans, the Mediterranean and the Adriatic Sea. El Nino and the Southern Oscillation.

Reference texts

- G.L. Pickard, W.J. Emery , Descriptive Physical Oceanography. V ediz. , Butterworth-Heinemann, .
- Open University Course Team, Ocean Circulation, Butterworth-Heinemann

**STATISTICS FOR EXPERIMENTAL SCIENCES
(STATISTICA PER LE SCIENZE SPERIMENTALI)
Prof. Giuseppe Scarponi**

Formative objectives

Aims. The course enables students to acquire the theoretical and methodological fundamentals, as well as the informatic techniques of explorative multivariate statistical analysis as applied to the study of experimental sciences.

Objectives. At the end the student should know the procedures of cluster analysis, principal component analysis, nearest neighbour rule, canonical variate analysis (discriminant analysis) as well as acquire the ability of performing the related informatic procedures for data analysis using commercial statistical packages.

Prerequisites

Knowledge of the topics of the courses on Mathematics, Informatics, General Statistics.

Programme

Theoretical and methodological fundamentals of the main techniques of explorative multivariate statistical analysis as applied to the study of experimental sciences. Multivariate data and information. Ungrouped data analysis: cluster analysis, principal component analysis (PCA). Grouped data analysis: k nearest neighbour rule (KNN), canonical variate analysis (CVA), discrimination and classification. Examples of case studies referred to biological, archeological (paleobiological) and chemical problems. Computer laboratory activity for the study of a few real cases considered during the course.

Teaching method of the course and assessment method

The course consists of theoretical lectures (2 credits, 18 hours) and computer laboratory practical work carried out individually (1 credit, 9 hours). The assessment method includes a written test and a computer practical test.

Bibliography

- *Lecture notes*
- O. Vitali. *Statistica per le Scienze Applicate*. Vol. 2, 1993. Cacucci Editore, Bari.
- O. Vitali. *Principi di Statistica*. Cacucci Editore, Bari, 2003.
- R.R. Sokal, F.J. Rohlf. *Biometry. The Principles and Practice of Statistics in Biological Research*, W.H. Freeman, San Francisco, 1995.
- W.J. Krzanowski. *Principles of Multivariate Analysis. A User's Perspective*, Seconda ediz., Oxford University Press, 2000.
- I.T. Jolliffe. *Principal Component Analysis*, Seconda ediz., Springer-Verlag, New York, 2002.

BIOMEDICAL LABORATORY SAFETY: BASIC HEALTH PROTECTION LEGISLATION (TUTELA DELLA SALUTE IN LABORATORIO: ELEMENTI DI LEGISLAZIONE SANITARIA) Dr. Lory Santarelli

The course aims at teaching students basic notions, also with reference to current laws and regulations, allowing the management of health and safety in biomedical laboratories; self-reliance in prevention activities; verification and control of procedures regarding hygiene in the workplace and environmental safety; awareness of physical, chemical and biological risk factors related to the main work cycles; appropriate application of basic techniques for sampling and analysing environmental pollutants.

- Legal framework of health protection in the workplace
- The concept of workplace health hazard: risk from carcinogenic, chemical, biological, and physical agents; the workplace microenvironment
- Occupational hazards in the biomedical laboratory
- Environmental and biological monitoring in the workplace
- Workers' health surveillance
- Main occupational pathologies
- General first-aid principles in the workplace.

Reference texts

Ambrosi - Foa': trattato di medicina del lavoro eds: Utet - Torino

**VIROLOGY
(VIROLOGIA)
Dr. Patrizia Bagnarelli**

Program

General virology: introduction to virology, virus structure, replication, culture and genetics, mechanisms of viral pathogenesis, laboratory diagnosis of viral diseases, antiviral agents and viral vaccines.

Specific Virus Families: DNA viruses (Parvoviruses, Adenoviruses, Poxviruses, Papillomaviruses and Polyomaviruses, Human Herpesviruses); RNA viruses (Orthomyxovirus, Paramyxovirus, Rubella Virus, Arboviruses, Rhabdoviruses, Arenaviruses, Hantaviruses, Filoviruses, Picornaviruses, Reoviruses, Coronaviruses, Retroviruses and HIV); Hepatitis Viruses.

Test books

1. **Jawetz, Melnick, and Adelberg's Medical Microbiology** Last edition.
Geo F. Brooks, Stephen A. Morse, Janet S. Butel
2. **Patrick Murray Ken Rosenthal G. Kobayashi M. Pfaller:
Medical Microbiology (Last Edition)**

COURSES AND TUTORIALS ON LINE

University of South Carolina

<http://pathmicro.med.sc.edu/book/virol-sta.htm>

University of Leicester

<http://www-micro.msb.le.ac.uk/3035/default.html>

All the Virology on the WWW

<http://www.tulane.edu/~dmsander/garryfavweb.html>

**ZOOLOGY
(ZOOLOGIA)
Prof. Giorgio Bavestrello**

Course syllabus:

Introduction: Biodiversity

Animal Biology

Ontogeny: gametes, fecundation, cleavage, gastrulation, larvae.

Principles of classification: the species concept and the super specific categories.

Protozoa: Flagellates, Amoeboid, Sporigenous, Ciliates.

Metazoa

Radial organisms

Sponges: Calcispongiae, Exactinellids, Demospongiae.

Cnidarians: Hydrozoa, Scyphozoa, Cubozoa, Anthozoa.

Ctenophores

Bilateral organisms

Platyhelminthes: Turbellaria, Digenea, Monogenea, Cestoda

Nemertea

Aschhelminthes: Nematoda, Rotifera and allied groups

Origin of the coelome

Sipunculida

Priapulida

Echiurida

Mollusca: Gastropoda, Bivalvia, Cephalopoda and allied classes

Anellida: Polychaeta, Oligochaeta, Hirudinea

Pogonophora

Arthropoda: Chelicerata, Mandibulata

Chelicerata: Merostomata, Arachnidi, Pycnogonida

Mandibulata: Crustacea, Myriapoda, Insecta

Bryozoa

Echinodermata: Asteroidea, Echinoidea, Ophiuroidea, Crinoidea, Oloturoidea

Protochordata

Chetognati

Chordata: Urochordata, Coephalochordata

Vertebrate evolution

Conclusion: animals and their habitats

Course and examination

During the course some practical sessions will be held.

The final examination is made up of a theoretical part and a practical part which is based on the study of macroscopic and microscopic specimens.

Reference texts:

Brusca & Brusca "Invertebrati" Ed. Zanichelli

Ruppert & Barnes "Zoologia, gli invertebrati" Ed. Piccin