Università Politecnica delle Marche

Dipartimento di Scienze della Vita e dell'Ambiente

Nucleo Didattico

CURRICULUM ACADEMIC YEAR A.A. 2009/2010				
CLASS L-13 (D.M. 270/04)				
Degree Course: BIOLOGICAL SCIENCES				
SUBJECTS	**SECTOR**	**CREDITS**	**Tot. Credits**	**Hours**
FIRST YEAR (common courses)				
Cytology and Histology	BIO/06	5	8	72
Chemistry I	CHIM/03		9	81
Mathematics	MAT/05		9	81
Physics	FIS/07		9	81
General Computer Science and Statistics	INF/01	2	5	45
	ING-INF/05	3		
Statistics for experimental sciences	CHIM/01	4	5	45
	ING-INF/05	1		
Zoology	BIO/05		8	72
English language			4	
Tot Credits			57	
SECOND YEAR (to be activated 2010-2011)				
Comparative Anatomy	BIO/06		8	72
Combined Course: Instrumental Analytic Chemistry and Biology Laboratory			9	81
* Instrumental Analytic Chemistry	CHIM/01	5		
* Biology Laboratory	BIO/09	4		
General Physiology	BIO/09		8	72
Botany	BIO/01		8	72
Chemistry II	CHIM/06		8	72
Biochemistry	BIO/10	7	8	72
	BIO/12	1		
Ecology	BIO/07	5	7	63
	GEO/02	3	8	72
Optional Credits*			8	/
Tot Credits			65	
THIRD YEAR (to be activated 2011-2012)				
Genetics	BIO/18		8	72
Molecular Biology	BIO/11		8	72
Plant Physiology	BIO/04		8	72
General Microbiology	BIO/19	4	8	72
	MED/07	4		
Development Biology	BIO/06	5	8	72
	BIO/13	3		
Optional Credits*			10	/
Practical Training			5	/
Final exam			5	/
Tot Credits			60	
Courses for optional credits				
Biomedical laboratory safety	MED/44		6	54
Marine Biology** (2nd year)	BIO/07		8	72
Bioorganic** (3rd year)	CHIM/06		8	72

Ethology	BIO/05		**6**	**54**
Fishery Biology	BIO/07		**6**	**54**
Human Anatomy	BIO/16		**6**	**54**
* At least 8 CFU must be acquired attending one of the course between Marine Biology or Bioorganic during the 2nd year				
** courses to be inserted in the career of students that didn't submit an individual curriculum, plus seminars for 2 CFU				
a) 1 credit= 9 hours. Together with the theoretical lectures, all courses must have at least 1 credit of experimental session				
b) combined courses involve various courses with only one final examination				
c) attendance is compulsory only for laboratory activities and practical training				
d) to take the third year examinations students have to have passed the English Language test				

CURRICULUM ACADEMIC YEAR 2009/2010				
CLASS L-32 (D.M. 270/04)				
Degree Course: ENVIRONMENTAL CONTROL SCIENCE AND CIVIL PROTECTION				
SUBJECTS	**SECTOR**	**CREDITS**	**Tot. Credits**	**Hours**
FIRST YEAR				
Combined Course: Chemistry				
General Chemistry	CHIM/03	6	12	108
Organic Chemistry	CHIM/06	6		
Physics	FIS/07		8	72
Statistical and Mathematical Methods	MAT/05		8	72
Geology	GEO/02		9	81
Plant Biodiversity	BIO/01		7	63
Animal Biodiversity	BIO/05		7	63
Fundamentals of biology	BIO/06		7	63
English Language			4	
	Tot Credits		62	
SECOND YEAR (to be activated 2010/2011)				
Fundamentals of Ecosystem Analysis	BIO/07	4	10	90
	BIO/01	2		
	BIO/05	4		
Applied Chemistry for Environmental Safeguard	CHIM/12	6	7	63
	ING-IND/25	1		
Safety and Environmental Analytical Chemistry	CHIM/01		8	72
Disaster and Civil Protection	GEO/05	4	7	63
	GEO/02	1		
	BIO/07	2		
Ecotoxicology and Environmental Impact Assessment	BIO/13		9	81
Fundamentals of climate and meteorology	GEO/12	6	7	63
	ING-IND/25	1		
Civil Protection Organization	IUS/14		6	54
Environmental Technical Physics	ING-IND/11		9	81
	Tot Credits		63	
THIRD YEAR (To be activated 2011/2012)				
Environmental Ethics and Legislation	BIO/07	5	7	63
	IUS/14	2		
Applied Ecotechnology	BIO/07	5	9	81
	INF/01	4		
Computer Instruments and Telecommunication for Environmental Civil Protection	ING-INF/05	3	8	72
	MAT/05	2		
	GEO/02	3		
Forecasting and Prevention of Natural Disasters	GEO/04	3	9	81
	BIO/07	4		
	MGGR/01	2		
Optional Credits*			12	/
Practical training			5	/
Final exam			5	/
Tot Credits			55	
Courses for optional credits				
Environmental Recovery Techniques**	ING-IND/25		6	54
Conservation of nature and its resources**	BIO/07		6	54
Analysis of Pollutants	CHIM/01		6	54

Environmental Microbiology	AGR/16-BIO/19		**6**	**54**
Applied Zoology	BIO/05		**6**	**54**
Environmental Monitoring	CHIM/12		**6**	**54**
Sanitary Emergencies	MED/41-MED/50		**6**	**54**
* At least 6 CFU must be acquired attending one of the two course between Environmental Recovery Techniques or Conservation of nature and its resources				
** courses to be inserted in the career of students that didn't submit an individual curriculum				
a) 1 credit= 9 hours. Together with the theoretical lectures, all courses must have at least 1 credit of experimental session				
b) combined courses involve various courses with only one final examination				
c) attendance is compulsory only for laboratory activities and practical training				
d) to take the third year examinations students have to have passed the English Language test				

CURRICULUM ACADEMIC YEAR 2009/2010				
CLASS LM-6 (D.M. 270/04)				
POSTGRADUATE PROGRAMME "APPLIED BIOLOGY"				
SUBJECTS	**SECTOR**	**CREDITS**	**Tot. Credits**	**Hours**
Curriculum Biological Technologies**				
FIRST YEAR				
Biotechnology of Microorganisms	AGR/16	4	6	54
	CHIM/11	2		
Bacterial Pathogens	MED/07		6	54
Molecular Biology II	BIO/11		5	45
Applied Genetics	BIO/18		5	45
Combined Course: Bioinformatics:			8	72
*Module 1	BIO/18	4		
*Module 2	FIS/07	4		
Biochemical Analyses	BIO/10		8	72
Applied and Industrial Biochemistry	BIO/10		12	108
Genetic Engineering	BIO/11		6	54
Optional Credits*			6	/
	First year credits		62	
SECOND YEAR (to be activated 2010/2011)				
Industrial Microbiology	AGR/16		6	54
Cell Biotechnology	BIO/06		6	54
Diagnostic Microbiology	BIO/19	2	6	54
	MED/07	4		
Practical Training or other Linguistic Skills			6	/
Optional Credits			6	/
Thesis			28	/
	CFU II Anno		52	
Student's choice courses*				
Applied Microbiology	AGR/16		6	54
Molecular Genetic	BIO/18		6	54
Chemical Analysis of Foods** (1st year)	CHIM/01		6	54
Food Biochemistry** (2nd year)	BIO/10		6	54
Medical and Molecular Virology	BIO/19		6	54
* At least 6 CFU must be acquired attending one of the following choice courses				
** degree course and courses for Optional Credits to be inserted in the career of students that didn't submit an individual curriculum				
Curriculum Biological Activities Compounds				
FIRST YEAR				
Molecular Biology II	BIO/11		5	45
Applied genetics	BIO/18		5	45
Chemical Biology	CHIM/11	4	8	72
	BIO/06	4		
Biomolecular Modeling and Design	CHIM/06	4	8	72
	BIO/11	4		
Applied and Industrial Biochemistry	BIO/10		12	108
Genetic Engineerng	BIO/11		6	54
Biomolecular Nanothechnologies	CHIM/05	4	6	54
	BIO/11	2		
Chemistry of Secondary Metabolism	BIO/10	3	6	
	CHIM/06	3		
Optional Credits			6	/

	Credits I year		**62**	
SECOND YEAR (to be activated 2010/2011)				
Receptors Structure and Chemistry	BIO/13	**4**	**6**	**54**
	CHIM/06	**2**		
Bioactive Heterocyclic Compounds	CHIM/06	**4**	**6**	**54**
	CHIM/11	**2**		
Research and Development of Bioactive Compounds	CHIM/06	**2**	**6**	**54**
	BIO/14	**4**		
Practical Training or other Linguistic Skills			**6**	**/**
Optional Credits*			**6**	**/**
Thesis			**28**	**/**
	Credits II year		**58**	
Student's choice courses*				
Enzymatic Techniques and Synthes	CHIM/11		**6**	**54**
Structural Determination Methods** (1st year)	CHIM/06		**6**	**54**
Molecular Biophysics** (2nd year)	FIS/07		**6**	**54**
Biopharmacology	BIO/14		**6**	**54**
Molecular Phisiology	BIO/09		**6**	**54**
* At least 6 CFU must be acquired attending one of the following choice courses				
** course for Optional Credits to be inserted in the career of students that didn't submit an individual curriculum				
a) 1 credit= 9 hours. Together with the theoretical lectures, all courses must have at least 1 credit of experimental session				
b) combined courses involve various courses with only one final examination				
c) attendance is compulsory only for laboratory activities and practical training - there are no compulsory prerequisite exams				
d) Practical training is not compulsory and has to be carryied out in structures outside the University for 150 hours				

CURRICULUM ACADEMIC YEAR 2009/2010				
CLASSE LM-6 (D.M. 270/04)				
POSTGRADUATE PROGRAMME "MARINE BIOLOGY"				
SUBJECTS	**SECTOR**	**CREDITS**	**Tot. Credits**	**Hours**
FIRST YEAR				
Biology of Reproduction	BIO/06		8	**72**
Marine Ecology	BIO/07		8	**72**
Marine Animal Biodiversity	BIO/05		8	**72**
Marine Sedimentary Environment Analysis	GEO/02		6	**54**
Psysical Oceanography	GEO/12		6	**54**
Ecopgisiology of the Algae	BIO/04		8	**72**
Marine Plant Biodiversity	BIO/01		8	**72**
Optional Credits*			6	**/**
	Credits I year		58	
SECOND YEAR (to be activated 2010/2011)				
Laboratory of Applied Marine Ecology	BIO/07		8	**72**
Marine Microbiology	BIO/19	6	8	**72**
	MED/07	2		
Methods in Ecotoxicology	BIO/13		8	**72**
Optional Credits			6	**/**
Practical Training or other Linguistic Skills			6	**/**
Thesis			26	**/**
	Credits II year		62	
Student's choice courses*				
Conservation of Nature and its Resources	BIO/07		6	**54**
Environmental Modeling	GEO/12		6	**54**
Evolutionary Biology of Marine Vertebrates** (1st year)	BIO/06		6	**54**
Technology for Marine Environment Protection	ING-IND/22		6	**54**
Aquaculture and Aquariums** (2nd year)	AGR/20		6	**54**
Fundamentals of Environmental Impact Assessment	BIO/07		6	**54**
Underwater Scientific Methodology	BIO/05		6	**54**
* At least 6 CFU must be acquired attending one of the following choice courses				
** to be inserted in the career of students that didn't submit an individual curriculum				
a) 1 credit= 9 hours. Together with the theoretical lectures, all courses must have at least 1 credit of experimental session				
b) attendance is compulsory only for laboratory activities and practical training - there are no compulsory prerequisite exams				
c) Practical training is not compulsory and has to be carryied out in structures outside the University for 150 hours				

CURRICULUM ACADEMIC YEAR 2009/2010				
CLASSE LM-75 (D.M. 270/04)				
POSTGRADUATE PROGRAMME "ENVIRONMENTAL SUSTAINABILITY AND CIVIL PROTECTION"				
SUBJECTS	**SECTOR**	**CREDITS**	**Tot. Credits**	**Hours**
FIRST YEAR				
Gis Tools for environmental and Civil Protection	GEO/05	2	6	**54**
	INF/01	4		
Environment and Civil Protection Legislation	IUS/14		6	**54**
Combined Course: Geologic and Climatic Risk			10	**90**
Geologic Risk	GEO/02	5		
Climatic Risk	GEO/12	5		
Energetic Resources and Alternative Energies	ING-IND/11		9	**81**
Sustainable Development and Ecological Economics	SECS-P/06	4	6	**54**
Environmental Sustainability	BIO/07	8	9	**81**
	BIO/01	1		
Chemical Risk and Ecocompatible Chemistry	CHIM/06		9	**81**
Biological and Ecological Risk	BIO/13		9	**81**
	Credits I year		64	
SECOND YEAR (to be activated 2010/2011)				
Integrated Systems for Environment Management and Remediation	ING-IND/25		8	**72**
Combined Course: Emergency Integrate Management			10	**90**
> Emergency Planning	BIO/07	5		
> Emergency Management	ICAR/20	5		
Medicine of Disasters	BIO/14	1	7	**63**
	MED/50	6		
Optional credits			8	**/**
Practical Training or other Linguistic Skills			5	**/**
Thesis			18	**/**
	Credits II year		56	
Student's choice courses				
Fire Prevention*	AGR/05-ING-IND/11		6	**54**
Environmental Modelling	GEO/12		6	**54**
Plant Physiology and Biomonitoring	BIO/04		6	**54**
Advanced Techniques in Environmental Chemical Analysis	CHIM/01		6	**54**
Environmental Mutagenesis	BIO/18		6	**54**
* course for optional credits to be inserted in the career of students that didn't submit an individual curriculum, plus seminars for 2 CFU				
a) 1 credit= 9 hours. Together with the theoretical lectures, all courses must have at least 1 credit of experimental session				
b) combined courses involve various courses with only one final examination				
c) attendance is compulsory only for laboratory activities and practical training - there are no compulsory prerequisite exams				
d) Practical training is not compulsory and has to be carryied out in structures outside the University for 150 hours				

BIOLOGICAL SCIENCE
ACADEMIC YEAR 2009/2010
CLASS L-13
COURSE CONTENTS

COMPARATIVE ANATOMY
(ANATOMIA COMPARATA)
Prof. Vincenzo CAPUTO

Aims: At the end of the formative way the student will have to know the bases of comparative anatomy of the vertebrates and to be able to evaluate the phylogenetic relationships among the various classes of vertebrates based on the comparison of the body plan in the different taxa. Furthermore the student will have to be able to explain the different morphological specialization from a functional point of view.

Previous Requirements: A basic knowledge of animal cytology and hystology and of embryology of chordates is required.

Topics:
1) Systematics and evolution of vertebrates. Plate tectonics; ecological crysis and mass extinctions; cronology of the geological eras and periods. The binomial system of the Linnean classification; nomenclatory rules; evolutionary systematics and the significance of jerarchical 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 the chordates (Urochordata, Cephalochordata and Vertebrata or Craniota); evolutionary affinity with Calcichordata and Emichordata; early phases of vertebrate evolution. Classification and evolution of the Agnatha: extinct armoured forms (pteraspids and cephalaspids) and hypothesis about the bone origin; the living agnathans (Petromyzontiforms and Myxinoidea). The rise of jaws and paired fins and the aquatic gnathostome radiation; classification of placoderms, acanthodians, cartilaginous and bony fishes. The land "conquest": the amphibian radiation; classification and evolution of amphibians ("Labyrinthodontia" and Lissamphibia). The full indipendence from water: the amniote radiation; classification and evolution of reptiles. The air "conquest": from feathered dinosaurs to Archaeopteryx; classification and evolution of birds. The mammals and evolution of endothermy; classification and evolution of mammals and mammal-like reptiles (pelycosaurs e therapsids). Classification and evolution of primates and man.
2) Anatomy. History of the Comparative anatomy. An outline of organogeny. Tegumentary system; scheletal system; muscular system; nervous system and sense organs; endocrine system; uro-genital system; circulatory system; respiratory system; digestive apparatus.

Textbooks:
Liem et al., 2002. Anatomia comparata dei Vertebrati: una visione funzionale ed evolutiva. EDISES.

HUMAN ANATOMY
(ANATOMIA UMANA)
Prof. Manrico MORRONI

Aims:
The student must know anatomical logic of the human organism
Previous Requirements:
Knowledge of the Histology
Topics:
Organization of the human body and anatomical terms. Skin.Skeletal apparatus. Circulatory system. Immune system. Respiratory system. Gastrointestinal tract. Urinary system. Male and female reproductive system. The endocrine glands. Central and periphery nervous system.
Textbooks:
1) Manrico Morroni: Anatomia microscopica funzionale dei visceri umani, Edi-Ermes, Milano, 2008.
2) Autori vari: Anatomia dell'Uomo, Edi-Ermes, Milano, 2006.
3) M. Morroni, M.Castellucci: Quesiti di autovalutazione di anatomia umana per i corsi di laurea triennali. Stampa Nova Editrice, Jesi (AN)
4) Manrico Morroni: Anatomia Microscopica Funzionale dei Visceri Umani, Edi-Ermes, Milano, 2008

BACTERIOLOGY
(BATTERIOLOGIA)
Prof. Francesca BIAVASCO

Aims: At the end of the course students will be required to know the structure and function of the bacterial cell parts, in the main their involvement in bacterial pathogenicity; antibiotic action and resistance, and horizontal genetic transfer mechanisms. They will also be required to know the bases of bacterial taxonomy, bacterial differentiation and communication strategies and to be familiar with bacterial identification and antibiotic susceptibility tests.

Previous Requirements:
Basic knowledge of biochemistry, cytology and general microbiology

Topics:
Overview of bacteriology. Structure, function, synthesis and assembly of bacterial envelopes. Flagella and bacterial motility, swimming and swarming motility. Fimbriae: structure and classification, involvement in virulence and in protein and DNA translocation. Adhesiveness to and internalization in epithelial cells; intracellular pathogens and their study techniques. Antibiotic mechanisms of action and strategies of bacterial resistance: antibiotics targeting cell-wall (β-lactams, glycopeptides), protein synthesis inhibitors (macrolides and lincosamides, aminoglycosides, tetracyclines), nucleic acid synthesis inhibitors (quinolones, rifampin), competitive inhibitors (sulfonamides, trimethoprim, isoniazid). Antibiotic susceptibility tests: Minimal Inhibitory Concentration (MIC), Minimal Bactericidal Concentration (MBC), killing curves. Horizontal gene transfer: mobile genetic elements (plasmid, transposable elements, conjugative transposons, integrons and genetic cassettes), types of horizontal gene transfer and their practical applications; filter mating. Origin, evolution and spread of antibiotic resistance; resistance, pathogenicity and catabolic islands.
Bacterial differentiation: the bacterial endospore, *Caulobacter*, cianobatteri, *Streptomyces*, *Rhizobium*. Viable but not culturable (VBNC) forms, *Quorum sensing*, bacterial biofilms.
Bacterial phylogenesis, classical and molecular taxonomy, the concept of species in bacteriology, the Bergey's manual. Identification and preservation of bacteria. Human diseases caused by bacteria, zoonosis.

Textbooks:
Prescott, Harley, Klein . Prescot, Harley and Klein's Microbiology, McGraw-Hill, 2008.
Salyers A.A. and Whitt D.D. Microbiology-diversity, disease, and the environment
http://pathmicro.med.sc.edu/book/bact-sta.htm
Specific material will be indicated and/or supplied at the end of the lessons**.**

APPLIED BIOCHEMISTRY
(BIOCHIMICA APPLICATA)
Prof. Fabio TANFANI

Aims:
The aim of the Course in Applied Biochemistry is to give information on 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.

Previous Requirements:
Knowledge in Chemistry and Biochemistry.

Topics:
Separation and purification of cells, subcellular fractions, and biological molecules.
Buffers in biochemistry. Homogenization of tissues and cells. Basic principles of sedimentation. Principles and applications of analytical, differential, and isopycnic centrifugation. Protein structure: folding and stability. Separation and purification of soluble proteins by fractional precipitation. Separation and purification of membrane proteins. Methods for the preparation of highly purified biomolecules.

Electrophoresis and blotting.
Basic principles of electrophoresis. Electrophoresis of polynucleotides. Electrophoresis of proteins: PAGE, disc.PAGE and SDS-PAGE. Isoelectric focusing. Bidimensional electrophoresis. Capillary electrophoresis. Blotting techniques.

Biological model membranes.
Methods for the preparation and characterization of multilamellar and unilamellar liposomes. Reconstitution of membrane proteins in liposomes. Application of liposomes in basic research.

Textbooks:
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, LT

BIOETHICS
(BIOETICA)
Dr. Massimiliano MARINELLI

Aims:
Modern biotechnology is a controversial as it is promising. Theaching the associated ethical issues can help engage students to learn the relevant sciencte concepts end to learn the skills necessary to contribute to ongoing social dialogue about science and society. In particular this cours will enable particpants to recognize e distinguish different views about the moral status of human embryo, and genetically modified animals.

Topics: a brief study of ethical theory, various approaches to bioethics pedagogy; how to relate bioethics issues to personal ethical issues familiar to student; how to help students identify ethical issues; the role of ethics and law in evaluating biotechnological developments.

Textbooks:
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, LT

FISHERY BIOLOGY
(BIOLOGIA DELLA PESCA)
Dr. Mario MORI

Aims:
The course aims to develop the topics and issues relating to systematic biology and ecology of key species to be fishing in the Mediterranean and their assessment and management.

Previous Requirements:

Topics:
Evolution of fishing gear. The state of fisheries in the world and in the Mediterranean and examples of overexploitation of resources (overfishing). Role of the biologist in the management of fishing resources. Description of the main fish species of the Italian seas. The most common fishing gear used in Italian fishing. Selectivity of fishing gear (target species and discarded). Parameters used to assess the demographic status of a fish population: meristic characters, size frequency, sex-ratio, age estimated by direct (Otoliths and scales) and indirect methods (resolution curves polymodal size-frequency), estimate growth using both linear and through the curve of Von Bertalanffy, stages of gonad maturation, size at first sexual maturity, fecundity, gonad-somatic indices and condition of Fulton, and health state. Food strategies of fish species and methods of study. Spatio-temporal distribution of fish resources (cycles, migration). The concept of stocks and methods for its identification. The factors of increase and decrease of a stock (age, recruitment, survival and mortality). Fishing effort and statistical systems for collecting data of fish production. Assessment of resource use: holistic (Schaefer model) and analytical models (VPA). Sampling methods for the assessment of demersal resources. The course will discuss various PC software useful in research on fisheries biology.

Textbooks:

AA.VV., 2001. La Gestione della pesca marittima in Italia. Fondamenti tecnico-biologici e normativa vigente. (A cura di M.E. Gramitto, Monografie Scientifiche, Serie Scienze e Tecnologie dell'Ambiente). Consiglio Nazionale delle Ricerche, Roma, Marchesi Grafiche Editoriali S.p.A., 319 p.
King M., 1995. - Fisheries Biology, Assessment and Management. Fishing News Books.
Sparre P., Venema S.C., 1998. - Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper, N. 306/1, Rev. 2, 407 p.

DEVELOPMENTAL BIOLOGY
(BIOLOGIA DELLO SVILUPPO)
Prof. Oliana CARNEVALI

Aims: The goal of this course is to rise in the student the ability to integrate information from different subject in order to acquire a global view of the mechanisms involved in embryo development in several different experimental models. The overall purpose of the course is to develop knowledge, understanding and skills necessary to study the general mechanisms involved in the development of a new organism in different experimental models.

Previous Requirements: Cytology, Genetics, Cellular and molecular biology and Biochemistry

Topics: Cytology, Genetics, Cellular and molecular biology and biochemistry

Textbooks: Biologia dello sviluppo , Gilbert 3° Ed Zanichelli

MARINE BIOLOGY
(BIOLOGIA MARINA)
Prof. Roberto DANOVARO

Aims:
To the end of the instruction the student will have to know the main interactions between the marine organisms and they ambient, vital cycles and adaptive strategies and the functioning of the marine ecosystems; the student will have to know to apply the main methodologies of study and to resolve the environmental problems relative to the contamination and the withdraw of biological resources. It will develop specific knowledge relative to the sampling, surveying and deepening of the various aspects of marine Biology.

Previous Requirements:
None

Topics:
History of Marine Biology, Principal characteristics of marine environments, Adaptation of the organisms to the marine environment and theirs 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.

Textbooks:
The students will base their study on the material provided during the lectures (more than 1000 slides)

Additional complementary infos can be found in the following textbooks
• Cognetti G., Sarà M., Magazzù G., **Biologia Marina**, Calderini, 1999.
• Barnes R.S.K., Hughes R.N., **Introduzione all'Ecologia marina**, Piccin, 1990.
• Ghirardelli E., **La vita nelle acque**, UTET, 1981.

MOLECULAR BIOLOGY
(BIOLOGIA MOLECOLARE)
Prof. Anna LA TEANA

Aims:

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.

Previous Requirements:
Citology, Biochemistry.

Topics:
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.

Textbooks:
J.D. Watson, T. Baker, S.P. Bell, A. Gann, M. Levine, R. Losick, "Biologia molecolare del gene" quinta edizione. Zanichelli, 2005.
B. Lewin, "Il gene VIII", Zanichelli, 2006.

FERMENTATION BIOTECHNOLOGY
(BIOTECNOLOGIA DELLE FERMENTAZIONI)
Prof. Maurizio CIANI

Aims: The aim of the course is to give the basic knowledge on micro-organisms and its modality of use in fermentation processes

Previous Requirements:
General microbiology, Biochemistry

Topics: Introduction: general arrangement and sectors of application; micro-organisms and products of industrial fermentations. Micro-organisms and fermentation. Taxonomic and systematic arrangement of

micro-organisms of use or potential use in the fermentation processes; microbial metabolism: main pathways of carbon and nitrogen metabolism and its 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 Collections of micro-organisms. Fermentation technology: Raw materials and the composition of substrate of fermentation. Fermentation process: batch, extended batch, batch with cell recycle, continuous process; kinetic of microbial growth and fermentation products; principal parameters of fermentation process.
Bioengineering Bioreactors: agitation and aeration technology, (oxygen transfer); measurements and regulations of principal fermentation parameters; fermentation plant (fundamental and auxiliary equipments, modality of sterilization. Product recovery.

Textbooks:
Scriban R. "Biotecnologia" Edagricole 1991
Moo Young M. "Comprehensive Biotechnology" Pergamon (Oxford) 1985
M. Manzoni Microbiologia Industriale CEA Editrice 2006

BOTANY
(BOTANICA)
Dr. Cecilia Maria TOTTI

Aims:
Aim of this course is to provide students with 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 (algae, fungi and land plants) will be treated in terms of morphological, anatomical and reproductive traits.

Previous Requirements:
Basic knowledge of physics and general and organic chemistry. It is recommended to pass the course of Citology and istology.

Topics:
Introduction to botany.
Prokaryotes: general characteristics of bacteria. Cyanobacteria: cell structure, morphology, reproduction, distribution and ecology.
Origin of chloroplast. and evolution of eukaryotes. The classification of eukaryotes: Opistokonta, Amoebozoa, Rhizaria, Archarplastida, Chromalveolata, Excavata. Algae. General characteristics of main algal groups: Rhodophyta, Dinophyta, Stramenopiles, 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, equiseta 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.

Textbooks:
PASQUA G., ABBATE G., FORNI C. Botanica generale e diversità vegetale. Piccin
LONGO C., MARZIANI G., 2005. *Biologia delle piante. Forme e funzioni elementari*. Utet.
TRIPODI G. Introduzione alla Botanica sistematica. Edises.

MARINE BOTANY
(BOTANICA MARINA)
Dr. Cecilia Maria TOTTI

Aims:

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 (algae, fungi and terrestrial plants) 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.

Previous Requirements:
Basic knowledge of physics and general and organic chemistry. It is recommended to pass the course of Citology and istology.

Topics:
Introduction to botany.
Prokaryotes: general characteristics of bacteria. Cyanobacteria: cell structure, morphology, reproduction, distribution and ecology.
Origin of chloroplast. and evolution of eukaryotes. The classification of eukaryotes: Opistokonta, Amoebozoa, Rhizaria, Archarplastida, Chromalveolata, Excavata. General characteristics of main algal groups: Rhodophyta, Dinophyta, Stramenopiles, Haptophyta, Cryptophyta, Euglenophyta, Chlorophyta.
Fungi: general characteristics and life cycles of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota. Lichenes.
Introduction to land plants. 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, equiseta and ferns. Some aspects about phylogeny of Pheridophytes.
Spermatophytes: Gymnosperms (Coniferophyta, Cycadophyta, Ginkgophyta); Angiosperms: (Monocotyledones and Dicotyledones) reproduction and life cycle; flowers, seeds, fruits.
Morphology and anatomy of Spermatophyta. Characteristics of eukaryotic plant cells: cell wall, plastids, vacuole. Tissues and organs: meristematic and adult tissues; morphological and anatomical characteristics of roots, stem and leaves.
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.

Textbooks:
PASQUA G., ABBATE G., FORNI C. Botanica generale e diversità vegetale. Piccin
LONGO C., MARZIANI G., 2005. *Biologia delle piante. Forme e funzioni elementari*. Utet.
TRIPODI G. Introduzione alla Botanica sistematica. Edises.
GRAHAM L.E., WILCOX L.W., 2000. *Algae*. Prentice Hall.

CHEMISTRY I
(CHIMICA I)
Dr. Elisabetta GIORGINI

Aims:
At the end of the course, the student will know and will be able to apply the fundamental principles of chemistry, such as nomenclature, molecular structure, acids and bases properties, pH of solution, exchanges of energy, etc.

Previous Requirements:
Basic knowledge of mathematic, physic and chemistry

Topics:
introduction to chemistry. Atomic theory. Atomic mass unit and mole. Atomic structure and Orbitals . Electronic configuration. Periodic table of elements. Nomenclature. Chemical bond. Oxidation number. Chemical reactions. Molecular geometry. Valence bond and molecular orbitals theories. Gas phase. Solid

and liquid phases. Thermodynamic and Thermochemistry. Cynetic. Physical equilibria. solutions. Chemical equilibria. Acids and bases. Ionic equilibria in solution. Electrochemistry.

Textbooks:
Atkins, Jones – PRINCIPI DI CHIMICA – ZANICHELLI
Silberberg – CHIMICA – Mc Graw Hill

CHEMISTRY II
(CHIMICA II)
Prof. Lucedio GRECI

Aims:
The aim of the course is to provide an understanding on 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. The knowledge of general chemistry is requested.

Previous Requirements:
The course requires the knowledge of General Chemistry

Topics:
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.

Textbooks:
W.H. Brown-Introduzione alla Chimica Organica – Ed. EdiSES
Morrison Boyd- Chimica Organica-Ed. Ambrosia
Mc Murry- Chimica Organica-Ed. Zanichelli
A. Zampilla et al.- Guida Ragionata allo svolgimento di Esercizi di Chimica organica-Ed. Loghia

INSTRUMENTAL ANALYTICAL CHEMISTRY
(CHIMICA ANALITICA STRUMENTALE)
Dott. Cristina TRUZZI

Aims:
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: classical (gravimetry, volumetry) and instrumental (potentiometry, conductimetry, UV-Vis spectrophotometry, fluorimetry, atomic absorption spectrofotometry, chromatography).

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.

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

Topics:
General introduction to the analytical process. Accuracy and precision. Traceability. General equipment of the analytical laboratory. Gravimetric and volumetric methodologies.. 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 titrations. Atomic absorption spectrophotometry (AAS). Sample atomization techniques. Instrumentation. Interferences. Atomic absorption analytical techniques. Fluorimetry: theory and instrumentation. Chromatographic techniques: theory and instrumentation. Gas chromatography (GC), High-Performance Liquid Chromatography (HPLC). A short account on capillary electrophoresis (CE).

Textbooks:
- Copy of slides available
- 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.
- D. A. Skoog, J. Leary. *Chimica analitica strumentale,* EdiSES, Napoli, 1995.

BIOCHEMISTRY
(CHIMICA BIOLOGICA)
Dr. Andrea Antonino SCIRÈ
(Analytical and Industrial Biology courses)

Aims:
The target of the course is to give a basic knowledge on the structure and function of the most important biological molecules and their role in the production and conversion of the metabolic energy.

Previous Requirements:
Basic knowledge of general and organic chemistry.

Topics:
Chemical bounds in biological chemistry. Fundamental organic molecules in living systems. Properties of biomolecules and adaptation to living conditions. Structure and function of proteins. The exploration of proteins. Outline of bioinformatics applied to proteins. Enzymes: basic concepts and kinetics, control strategies. 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.

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

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

Aims:
The target of the course is to give a basic knowledge on the structure and function of the most important biological molecules and their role in the production and conversion of the metabolic energy.

Previous Requirements:
Basic knowledge of general and organic chemistry.

Topics:
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. Antartic 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. 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. Oxidation of fatty acids, biogenesis of cholesterol, steroid hormones. Proteins turnover and aminoacid catabolism. Transduction of biological signals at the membrane level and the molecular basis of the action of hormones.

Textbooks:
- 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.

APPLIED ORGANIC CHEMISTRY
(CHIMICA ORGANICA APPLICATA)
Dr. Roberta GALEAZZI

Aims:
At the end of the course, the student will be aware that at the basis of relevant biological events there are often simple chemistry reactions which produce important macroscopical variations.The structure and the synthesis of nucleic acids must be well known, together with the principle interactions between external agents and DNA or RNA.

Previous Requirements: CHEMISTRY I and II

Topics:
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 deossiribonucleotides both in solution and solid phase. Antiviral chemotheraphy. DNA interaction with UV light. Oligonucleotides Antisense.

Textbooks:
Eds. G.M.Blackburn, M.J.Gait, *Nucleic Acids in Chemistry and Biology*, Oxford University Press,1996.
R.J.Simmons,*Chemistry of Biomolecules: An introduction*., Springer Verlag, 1992.

CYTOGENETICS
(CITOGENETICA)
Dr. Roma MAGISTRELLI

Aims:
knowledge of the structure and the function of chromosomes-knowledge of the origin of structurally abnormal chromosomes and about the abnormalities of human chromosome number-knowledge of the genetic risk of abnormal offspring-knowledge of banding techniques and molecular methods on human chromosomes

Previous Requirements:
knowledge of mitosis and meiosis

Topics:
origins and direction of Cytogenetics-chromosomes organization: centromeres;kinetochores and telomeres-constitutive and facultative heterochromatin-polytene chromosomes and lumpbrush chromosomes- human karyotipe- banding techniques- FISH- chromosome structural aberration- numerically abnormal chromosome constitution-genomic imprinting- mutagenesis studies- chromosomes and cancer- prenatal studies- tissue colture-hybrid cells

Textbooks:
P.Sudbery "Genetica Molecolare Umana" Zanichelli
E.Therman, M.Susman "Human Chromosomes" Springer-Verlag
P.A.Hoffee "Genetica Medica Molecolare" Zanichelli

CYTOLOGY AND HISTOLOGY
(CITOLOGIA ED ISTOLOGIA)
Prof. Ettore OLMO

Aims:

At the end of the course the student will know in depth the composition and structure of the cell organelles; the cell cycle and its functional steps, mitosis and meiosis. Moreover he will acquire the knowledge of the differentiations of the animal tissues, with special reference to the human histology and of the basic principle of the chordates' embryonic development.

Topics:
Cytology: General properties of living organisms; the level of organization of living organisms: virus, prokaryotes and eukaryotes; chemistry of the cells; cellular membranes, plasma membrane and its function; differentiations of the cell surface (microvilli, cilia and flagella, cell junctions); cytoskeleton; ribosomes and protein synthesis; smooth and rough endoplasmic reticulum; Golgi body and exocytosis; lysosomes and endocytosis; mitochondrion and energetic cycle; chloroplast and photosynthesis; nuclear envelope and nucleo-cytoplasmic exchanges; chromatin (euchromatin and heterochromatin) structure and composition; nucleoskeleton; metaphasic chromosomes; Diploid and aploid chromosome set; RNA transcription; DNA duplication; mitosis; meiosis.
Outline of Embryology: Gametogenesis; reproductive cycle; fertilisation; cleavage; Amphioxus gastrulation.
Histology: Epithelial tissue and glands; connective tissues (cells and fundamental substance; connectives, cartilage, bone, blood); muscular tissue (smooth, striated, cardiac); nervous tissue and nevroglia.

Textbooks:
R. Colombo e E. Olmo. Biologia della Cellula, EdiErmes, Milano;
R. Colombo e E. Olmo. Biologia dei Tessuti, EdiErmes;
E. Olmo Elementi di Embriologia comparata, CLUA, Ancona.
Copies of all the textbooks are present at the Library in Monte Dago pole.

ECOPHYSIOLOGY OF AQUATIC PLANT ORGANISMS (ECOFISIOLOGIA ORGANISMI VEGETALI ACQUATICI)

Prof. Mario GIORDANO

Aims:
Aim of this course is to allow the students to acquire a thorough understanding of the main concepts in aquatic photolithotrophs ecophysiology. In addition to this the student will acuire the ability to independently and creatively analyze primary sources of information and to use them in a scientific/reserach context..

Previous Requirements:
-Literature search skills
-Sufficient knowledge of the Enlgish language to allow comprehension of the scientific literature
-Thorough knowledge of chemistry, biochemistry and physical-chemistry, and plant/algae cytology
-Basic knowledge of algae and plant structure and of their phylogenetic relationships

Topics:
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
CO_2 concentrating mechanisms
Non-photosynthetic carbon metabolism
Main aspects of nitrogen metabolism
Metabolic interactions and regulation

Textbooks:
Buchanan, Gruissem and Jones (2004). Biochimica e Biologia molecolare delle Piante. Zanichelli
Falkowski e Raven (1997). Aquatic Photosynthesis. Blackwell
Zeebe and Wolf-Gladrow (2002). CO_2 in Seawater: Equilibrium, Kinetics, Isotopes . Elsevier
Kirk (1994). Light and Photosynthesis in Aquatic Ecosystems. Cambridge University Press

ECOLOGY
(ECOLOGIA)
Dr. Antonio PUSCEDDU

Aims:
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 include basics of population dynamics and biotic and abiotic factors that regulate temporal and spatial fluctuations of natural population

Previous Requirements:
None

Topics:
Ecosystems properties; the energy flux; ecological efficiency; fitness and adaptation; abiotic factors controlling ecosystems; resources and consumers; population ecology principles; life tables; recruitment; population growth in limited and non-limited environment; density-dependent control of population size; r and K dichotomy; competition and predation; basic mathematical models of competition and predation; ecological niche; successions; biodiversity and ecosystem functioning relationships

Textbooks:
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. 48
R.R. Ricklefs, **ECOLOGIA**, Zanichelli, Bologna, 1997

ECOTOXICOLOGY
(ECOTOSSICOLOGIA)
Prof. Francesco REGOLI

Aims:
The Course of Ecotoxicology is aimed to prepare students for the study of environmental pollution, with particular emphasis to the toxicological implications of chemicals on various biotic components. At the end of the Course the student should have the capability to:
1. Describe main characteristics of chemicals and environmental distribution pathways.
2. Know topics related to biomagnification, use of bioindicator organisms and biomarker analyses.
3. Use the main analytical methodologies for both chemical residues and cellular responses.
4. Organize and plan a biomonitoring program, choose bioindicators, define appropriate biomarkers to investigate.

Previous Requirements:
A good knowledge of basic chemistry, ecology, general and cell biology are important requisites for this course.

Topics:
The Course of Ecotoxicology and Environmental Impact Assessment is based on both theoretical lessons and practical exercitations. Lessons will cover the following topics:
- Introduction and objectives of environmental toxicology. Main classes of environmental pollutants and their distribution. Toxicity tests, general procedures, interpretation of results, applicability; main tests for waters and sediments. – Bioconcentration, bioaccumulation and biomagnification. Use of organisms as bioindicators. Metabolism, detoxification and toxicity of chemical pollutants. Biomarkers at molecular-cellular level with predictive and diagnostic value. Effect and exposure biomarkers. Biotransformation and toxicity of polycyclic aromatic hydrocarbons, halogenated compounds, pesticides, PCBs and dioxin-like chemicals. Detoxification and toxicity of trace metals. Lysosomes, peroxisomes, antioxidant defenses and oxidative stress as biomarkers of environmental pollutants. Environmental genotoxicity and DNA damages, immunotoxicity to invertebrates and fish. Liver pathologies and chemical carcinogenesis. Pollutants with endocrine disrupting properties. – Ecotoxicological approach in environmental impact assessment. General and economical aspects. Use of biological and environmental resources, industrial development and risks, dangerous substances. National and international guidelines to prevent and monitor environmental pollution: limits and perspectives of ecotoxicological approach. Definition of quality standard for aerial, terrestrial and

aquatic environments. Electromagnetic fields, presence, distribution and biological effects. Use of terrestrial bioindicators for monitoring atmospheric and soil pollution. – Case studies of environmental impact assessment in harbour environments. Management criteria for dredging and remediation of polluted sediments. Remediation of national priority sites, plans for characterization and technical operations; normative aspects and interactions with ecotoxicological studies. Examples of environmental impact assessment in polluted areas during the remediation: conceptual and methodological issues. The course has also a practical phase; students will plan a monitoring study, choosing both bioindicators organisms and biomarkers. The main technical methodologies will be presented and carried out by the students. Critical analysis of results will be discussed in terms of environmental impact assessment.

Textbooks:
Provided materials and scientific literature suggested on specific topics.
Fundamentals of Aquatic Toxicology. Edited by Gary M. Rand, Taylor & Francis 1995
Biomarkers in Marine Organisms: a practical approach. Edited by Garrigues et al., Elsevier 2001

ETHOLOGY
(ETOLOGIA)
Dr. Stefania PUCE

Aims:
At the end of the course the student should have the ability to analyze the animal behaviour following the scientific method.

Topics:
Animal behaviour in evolutional perspective.
Instinct and learned behaviour.
Evolutional base of the instinct and the learned behaviour.
Genetic base of the behaviour.
Nervous system and behaviour.
Historic evolution of the 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.

Textbooks:
Alcock, Etologia, un approccio evolutivo. Zanichelli

PHARMACOLOGY
(FARMACOLOGIA)
Dr. Lamberto RE

Aims:
The course is established to widen the knowledge in clinical pharmacological field with particular reference to the basic notions during the Course of Pharmacology. The purpose will be that to furnish useful elements for the formation of specialized professional figures devoted to the scientific information in the medicinal field. The treated matters will be fundamental besides for professional results in firms of the pharmaceutical sector, with particular respect to the field of the ethno-botanic and to the homeopathy.

Previous Requirements:
Suitable knowledge of general physiology, neurochemistry and biochemistry.

Topics:
Definition of receptor, agonist and antagonists. Molecular mechanisms at the base of the pharmacological action: constant of affinity, equipotent dose 50, curves dose effect and principles of the law of action of mass. Pharmacokinetics and formality of administration of the medicines. Calculation of the plasmatic half-life and volume of distribution. Function of the principal pharmacological receptors: adrenergic and cholinergic. Concept of synapses and nicotinic receptors.
Legislation on the drug marketing. Notes on the dietary supplements, homeopathic medicines, cosmetic medicines and natural derived drugs. Methods of epidemiological evaluation on the drug action: pre-clinic phases, randomized studies, post-marketing pharmaco-vigilance. Symptomatic and etiologic drugs, interactions among medicines. Therapeutic approaches and dosages: antibiotic, antiviral, cardiovascular. Medicines of the peripheral nervous system and of the central nervous system: neuromuscular, anaesthetic and psychotropic drugs. Anti-inflammatory, hormones.
Adverse drug reactions (ADR's), abuse of medicines and pharmaco-dependence, toxicology, prescription. Notes of complementary therapies to the pharmacological treatment (CAM): Homeopathy, Naturopathy, Oxygen-Ozone Therapy, Biological Medicine.

Textbooks:
Goodman and Gilman, Zanichelli;
Farmacologia e Terapia Medica, Kalant Roschlau, Casa Editrice Ambrosiana;
Lessons of the Courses..

PHYSICS
(FISICA)
Prof. Paolo MARIANI

Aims:
The present course in Physics is concerned with the study of matter, energy, forces, and their interaction in the world and universe around us. The present curriculum includes 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. The course will provide the student with the necessary competences on the physical basic laws and concepts (both theoretical and experimental) to study and to understand the physical properties of the biological matter in the frame of the life and environmental sciences.

Previous Requirements:
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).

Topics:
Introduction to Physics. Physical values, measurements, units and standards. Kinematic of material point. Dynamic of material point. Kinematic of rigid body. Dynamic 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 field.
The course is divided in 63 hours of lectures and 18 hours of practical work, which will be performed in the Student Physics Laboratory of the University.

Textbooks:
- Giambattista, Richardson & Richardson, "College Physics", Second edition, McGraw-Hill, 2007.

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

Aims:
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);
• how to use physics and physical chemistry for the study of animal organs and apparatuses;
• the understanding of the main research methods in Physiology, in theory and practice;
• methods of choice and problem solving in physiological studies.

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

Topics:
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 ad 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.

Textbooks:
• C. Casella V. Taglietti, Principi di Fisiologia - Volume I e II, La Goliardica Pavese.
• L. Sherwood, Fisiologia Umana, Zanichelli.
• D.U. Silverthorn, Fisiologia, Casa Editrice Ambrosiana

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

Aims:
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);
• how to use physics and physical chemistry for the study of animal organs and apparatuses;
• the understanding of the main research methods in Physiology, in theory and practice;
• methods of choice and problem solving in physiological studies.

Previous Requirements:
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. Some basic Biochemistry would also be beneficial.

Topics:
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 ad 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. 50
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.

Textbooks:
• C. Casella V. Taglietti, Principi di Fisiologia - Volume I e II, La Goliardica Pavese.
• L. Sherwood, Fisiologia Umana, Zanichelli.
• D.U. Silverthorn, Fisiologia, Casa Editrice Ambrosiana.

PLANT PHYSIOLOGY
(FISIOLOGIA VEGETALE)
Prof. Aurelio DE SANTIS

Aims:
At the end of the course the student will be able to manage theoretical and working knowledge of molecular processes and functions (at cellular and whole plant level) of importance for higher plant growth and development in both agriculture and food production and processing.

Previous Requirements:
Biochemistry and Ecology

Topics:
Transport physiology: Chemical potential 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+ ion signalling. Responses to abiotic stresses such as drought, salt and cold.

Textbooks:
W.G. HOPKINS, N.P.A. HÜNER Introduction to Plant Physiology, Wiley International Edition
L. TAIZ, E. ZEIGER Plant Physiology, Sinauers Associates, Inc. Pub.
F.B. SALISBURY, C.W. ROSS Plant Physiology, Wadsworth Publishing Company.

GENETICS
(GENETICA)
Prof. Davide BIZZARO

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

Previous Requirements:
A good knowledge of Cytology, General Biology and Zoology is required.

Topics:
Introduction: the cell cycle; mitosis and meiosis from the genetic viewpoint; 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 human genes: from DNA extraction to PCR and gel fragments analysis of gene polymorphisms

Textbooks:
P. J. RUSSEL, i*Genetica* II^{a} edizione. Edises, 2007.
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
L. H. HARTWELL et al., *Genetica - dall'analisi formale alla genomica.* Mc Graw-Hill 2006

MARINE GEOLOGY
(GEOLOGIA MARINA)
Prof. Massimo SARTI

GENERAL GEOLOGY

- Interior of the Earth. Crust, mantle, nucleus, Mohorovicic discontinuity. Lithoshere and astenosphere. 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, palaeontolological 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. Plane 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 eteropy. 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.

COMPUTER SCIENCE (INFORMATICA)
Prof. Piero MONTECCHIARI

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

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

Textbooks: Tosoratti, Introduzione all'Informatica, Ambrosiana

BIOORGANIC CHEMISTRY LABORATORY (LABORATORIO DI BIOORGANICA)
Prof. Mario ORENA

Aims:
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 understanding and using the processes by which peptides are obtained, in order to design new bioactive peptides.

Previous Requirements: Basic Organic Chemistry

Topics:
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.

Textbooks: P.M. Dewick, Medicinal Natural Products, Wiley, 2004

MATHEMATICS
(MATEMATICA)
Prof. Piero MONTECCHIARI

Aims: Aim of the course is to provide basic knowledge and tools of calculus for functions of one real variable. At the end of the course the student has to be able to solve exercises and problems concerning the differential and integral calculus for functions of one real variable. Secondly he has to be able to properly enunciate and prove the theorems discussed in the course.

Previous Requirements: Basic elements of Calculus and Analytic Geometry

Topics: Sets, Relations and Functions. Composition, invertibility. Natural, Integer, Rational and Real numbers. The Induction principle. Supremum, infimum, maximum, minimum. Modulus and powers. Exponential, logaritmic and angular functions. Limit of real sequences and its properties. Indeterminate forms. Monotone sequences. The Neper's number and related limits. Asymptotic comparison. Limits of real function of real variable. Properties. Indeterminate forms. Monotone functions. Asymptotic comparison. Continuity; The Weierstrass's and the Intermediate Values Theorems. Derivative and Derivative Formulas. Successive Derivative. The Fermat's, Rolle's, Lagrange's and Cauchy's Theorems. Derivative and monotonicity. Convexity. Primitives. The 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. The Bernoulli's equations. The Malthus and Verhulst models for the population dynamics.

Textbooks:
P. Marcellini - C. Sbordone, Elementi di Calcolo, Liguori editore
P. Marcellini - C. Sbordone, Esercitazioni di matematica vol. 1 (parte I e II), Liguori editore

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 polysaccarides, 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. **Microscopy, preparation and staining of specimens 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. Disk diffusion susceptibility test.**
Microbial ecology and microorganism-host interactions. Microbial communities. Symbiotic interactions: commensalism, mutualism, parasitism. Pathogenicity and virulence: adhesiveness, invasiveness and toxin production. Endotoxins and esotoxins. Nonspecific and specific human body defenses.
Immunology:: antigens and antibodies, cells involved in the immune response, vaccines.
Basic environmental, food and industrial microbiology.

Aims:
At the end of the course the students will be required to have learnt the structure and metabolic features of the different groups of microorganisms; the interactions of microorganisms among themselves, with other living organisms and with the environment; the microbial pathogenicity and host defence mechanisms; the bases of microorganism cultivation and their control by physical and chemical agents. They will also be aware of the different fields of application of Microbiology.

Previous Requirements:
Basic biochemical and cytology knowledge

Topics: The course will introduce the students to the world of microbes, the structural and metabolic features of the main groups of prokaryotes, the interactions of microorganisms among themselves, with other living organisms and with the environment. The students will also become familiar with the methods of cultivation, observation and identification of microorganisms and the control of microbial growth by physical and chemical agents.

Textbooks:
Wiley M., Sherwood M., Woolverton. J. Prescott, Microbiologia: Microbiologia generale (1° vol.), 2009
Prescott, Harley, Klein “Microbiologia”, McGraw-Hill 2006.
Madigan, Martinko, Parker. Brock-Biologia dei microrganismi. Casa Editrice Ambrosiana, 2007. Volume1.
Schaechter, Ingraham, Neidhardt “Microbiologia”. Zanichelli, 2007.
Salyers, Whitt. “Microbiologia”. Zanichelli, 2002.

OCEANOGRAPHY (OCEANOGRAFIA)
Dr. Aniello RUSSO

Aims: By the end of the course, the student will must to know the basic mechanisms and processes of the physical oceanography which rule the circulation and the main physical properties of the sea, as well as to describe the main characteristics of the oceans, of the Mediterranean Sea, of the Adriatic Sea.

Previous Requirements: none, it is advisable a good knowledge of math and physics

Topics:
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 the wind-driven circulation. Upwelling and downwelling. Thermohaline circulation. Deep and intermediate waters 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, Mediterranean and Adriatic Sea. El Niño and the Southern Oscillation.

Textbooks:
G.L. Pickard e W.J. Emery, "**Descriptive Physical Oceanography",** 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 univariate and multivariate statistical analysis as applied to the study of experimental sciences.

Objectives. At the end the student should know the fundamentals of statistics, the hypothesis testing, the analysis of variance and 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 and Informatics.

Programme
Theoretical and methodological fundamentals of the main techniques of univariate and multivariate statistical analysis as applied to the study of experimental sciences. Hypothesis testing. Analysis of variance. 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 (4 credits, 36 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.

Textbooks
- *Lecture notes*
- O. Vitali. *Principi di Statistica*. Cacucci Editore, Bari, 2003.
- O. Vitali. *Statistica per le Scienze Applicate*. Vol. 2, 1993. Cacucci Editore, Bari.
- 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 (TUTELA DELLA SALUTE IN LABORATORIO) Prof. Lory SANTARELLI

Aims:

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 at 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 of environmental pollutants.

Previous Requirements: none

Topics:
BIOMEDICAL LABORATORY SAFETY: BASIC HEALTH-PROTECTION LEGISALATION

- 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
- Surveillance by health authorities
- Main occupational pathologies
- General first-aid principles at the workplace.

Textbooks:
ENVIRONMENTAL SAFETY - by Alessandro Medici- Università di Ferrara anno edizione: 2003 - Casa Editrice La Tribuna – Piacenza;
OCCUPATIONAL MEDICINE Luigi Ambrosi; Vito Foà anno edizione 2003 Edizioni : UTET C.so Raffaello 28-10125-Torino.

VIROLOGY
(VIROLOGIA)
Dr. Patrizia BAGNARELLI

Aims:
The course is organized in a number of lectures arranged into two parts. The part one deals with general virology (virus definition, morphology, classification, replication strategies, viral genetics, viral vaccines and chemotherapy); the part two deals with the specific virus families focusing on their distinctive characteristics
The principal aim of the course is to provide students with a thoroughly and complete knowledge on the viral agents involved in a number of human infectious diseases. This knowledge could be useful for a future employement in a Microbiology lab at a Hospital or University setting.

Previous Requirements:
Basic principles of cell biology and innate/adoptive mechanisms of the immune defence

Topics:
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, Flaviviruses, Rhabdoviruses, Arenaviruses, Hantaviruses, Filoviruses, Picornaviruses, Reoviruses, Coronaviruses, Retroviruses and HIV); Hepatitis Viruses.
Textbooks:
Jawetz, Melnick, and Adelberg's “Medical Microbiology” Last edition.
Patrick Murray Ken Rosenthal G. Kobayashi M. Pfaller: “Medical Microbiology” (Last Edition)

ZOOLOGY
(ZOOLOGIA)
Prof. Giorgio BAVESTRELLO

Aims:
Teacher aims to provide students with the knowledge of animal biodiversity through a detailed description of their organisation at cell and anatomical level. Reproductive strategy and ecology will be also considered.

The phylogenetic relationships among phyla will be outlined.
Finally some basic aspects of general zoology will be treated.
At the end of course, students should know animals at morphological level with details regarding their cellular organisation and anatomy, reproductive strategies and ecology.
He should know also the phylogenetic relationships among phyla will be presented.
Finally, he should know the basic aspects of general zoology.

Previous Requirements:
It is recommended to pass the course of Citology and Istology

Topics:
Introduction: Biodiversity
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

Textbooks:
Brusca & Brusca “Invertebrati” Ed. Zanichelli
Ruppert & Barnes “Zoologia, gli invertebrati” Ed. Piccin

Environmental control techniques/sciences and civil PROTECTION
ACADEMIC YEAR 2009/2010
CLASS L-32
COURSE CONTENTS

ANALYSIS OF POLLUTANTS
(ANALISI DEGLI INQUINANTI)
Dr. Anna ANNIBALDI

Aims:
Knowledge of basic principles and application of advanced analytical techniques.
Knowledge of extraction methods and principal analytical methodologies for priority pollutants.
Ability to perform instrumental analysis on environmental matrices for pollutant analysis.

Previous Requirements:
Knowledge on inorganic chemistry, organic chemistry and instrumental analytical chemistry.

Topics:
General part
- Determination of pollutants in accordance with government dispositions
- Analytical definition and choice of procedure (techniques, methods and procedures)
- sampling

The sample
- sampling methods
- sample treatment (procedures)
- sample storage (material and contamination)
- extraction methods for environmental analysis
    - Liquid-Liquid extraction
    - Solid Phase Extraction (SPE)
    - Solid Phase Micro-Extraction (SPME)
    - Solid-Liquid Extraction
    - Soxhlet and Soxtec methods
    - Accelerated solvent extraction
    - Microwave extraction

Analysis
Application of instrumental analytical techniques for pollutant analysis.
Chromatographic techniques:
- high pressure liquid chromatography (HPLC)
- Fast and Ultra Fast HPLC
- gas-chromatography (GC)
- mass spectrometry: coupling HPLC-MS and GC-MS
- High Resolution GC-MS (GC-HRMS)
- inductively coupled plasma mass spectrometry (ICP-MS)

Data analysis
Quality of analytical data: accuracy and precision, repeatability and reproducibility, detection limit, validation of analytical data.

Pollutants and their analytical treatment
Dangerous and priority pollutants.
Inorganic pollutants: metals and metallic species. Preliminary sample treatment by acid mineralization. Preconcentration methods for trace metals determination. Determination of arsenic, chromium, nichel, lead, cadmium, mercury, alkyl-metals.
Organic pollutants: volatile organic compounds (VOC), semivolatile organic compounds, phenols and alophenols, antiparasitic agents, pesticides, polycyclic aromatic hydrocarbons (PAH), polychlorobiphenyls (PCB), dioxins and furans.

Textbooks:

- Copy of slides available
- J.R. Dean, **Extraction methods for environmental analysis**, John Wiley & Sons, 1999
- R. Cozzi, P. Protti, T. Ruaro, **Elementi di analisi chimica strumentale**, Zanichelli, Bologna, 1998.
- K.A. Rubinson, J.F. Rubinson, **Chimica Analitica Strumentale**, Zanichelli, Bologna, 2002.
- D.A. Skoog, J.J. Leary, **Chimica analitica strumentale**, EdiSES, 4° Edizione.
- APAT, **Metodi analitici per le acque, manuali e linee guida 29/2003, APAT.**, 2003.

ANIMAL BIODIVERSITY
(BIODIVERSITÀ ANIMALE)

Prof. Giorgio BAVESTRELLO

Aims:

Aim of the course is the knowledge of animal biodiversity through a basical description of their organisation at cell and anatomical level. Reproductive strategy and ecology will be also considered.
The phylogenetic relationships among phyla will be outlined.
Finally some basic aspects of general zoology will be treated.
At the end of course, students should know animals at morphological level with details regarding their cellular organisation and anatomy, reproductive strategies and ecology.
Finally, he should know the basic aspects of general zoology.

Previous Requirements:

It is recommended to pass the course of Basical Biology

Topics:

Introduction: Biodiversity
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
Anellida: Polychaeta, Oligochaeta, Hirudinea
Pogonophora
Arthropoda: Chelicerata, Mandibulata
Bryozoa
Echinodermata: Asteroidea, Echinoidea, Ophiuroidea, Crinoidea, Oloturoidea
Protochordata
Chetognati
Chordata: Urochordata, Coephalochordata
Vertebrate evolution

Textbooks:

Dorit, Walker & Barnes, Zoologia, Zanichelli
Hickman et al., Fondamenti di Zoologia , Ed McGraw-Hill

PLANT BIODIVERSITY
(BIODIVERSITÀ VEGETALE)

Dr. Alessandra NORICI

Aims: the course teaches the functional meaning of plant structures, plant evolution and plant adaptations to the environments.

Previous Requirements: basic cytology and botany

Topics:
Classification and systematics: essential concepts, classification systems, characters and types of information used in taxonomic analysis

The three groups of living organisms: Bacteria, Archea, Eukarya
The spread of photosynthesis and its main features

Photosynthetic prokaryotes: cell structure, cell division and reproduction, classification, Cyanophyta

Hypothesis on eukaryote origin and, in particular, on the chloroplast origin

Algae: general features (thallus organizations, algal specific cell structures, flagella, reproduction), Chlorophyta, Rhodophyta, Glaucophyta, Dinophyta, Euglenophyta, Heterokontophyta, Prymnesiophyta, Cryptophyta, Chlorarachniophyta.
Land Plants: origin and evolution, general concepts, Bryophyta, Hepatophyta, Anthocerotophyta.
Vascular Plants without seeds: general features, early vascular plants, Lycophyta, Arthrophyta, Pteridophyta
Gymnosperms: general concepts, seed evolution, Coniferophyta, overview of other divisions
Angiosperms: root, shoot with leaf, flower, fruit; origin of the angiosperms, Monocotyledons, Eudicotyledons and other groups; interaction between rhizobium and leguminosae; mangroves and seagrasses: functional adaptations to the environment.

Fungi: general features (thallus, vegetative and reproductive structures, nutrition, metabolism and physiology); main phyla: Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota
Symbiotic relationships of fungi: interaction between fungi and algae: lichens; interaction between fungi and plants: mycorrhizae

Plant biodiversity and global climate change: plant adaptation to the main changing environmental factors (solar radiations, temperature, water and nutrient availability)

Herbaria and botanical gardens
Plant biotechnology

Textbooks:
Mauseth JD; Botanica-Biodiversità, Idelson Gnocchi;
Pasqua G, Abbate G, Forni C; Botanica generale e diversità vegetale, Piccin Nuova Libreria
Raven PH, Evert RF, Eichhorn SE; Biology of Plants , WH Freeman & Company Publishers

ANALYTICAL AND ENVIRONMENTAL CHEMISTRY (CHIMICA ANALITICA E AMBIENTALE)

Prof. Giuseppe SCARPONI

Formative objectives

Aims. The course enables students to acquire the knowledge of main techniques and methodologies for chemical analysis, and their applications in environmental field. It allows also students to acquire the basic concepts on global changes, on local pollution and on environmental safety.

Objectives. To know the chemical analytical methodologies of gravimetry, titrimetry, potentiometry, conductimetry, UV-Vis spectrophotometry and polarography, as well as to acquire the basic knowledge of main global environmental changes and local chemical pollution. The student should also acquire the following professional skills: ability to carry out basic laboratory chemical analyses devoted to the analytical control of environmental matrices.

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

Programme
Fundamentals of chemical analysis. Phases of the analytical process. Laboratory techniques for quantitative chemical analysis. Classical analytical methods of gravimetry and volumetry. Some instrumental analytical techniques: electrochemical (potentiometry, conductimetry, polarography) and spectrochemical (UV-Vis spectrophotometry). Quality of analytical data and elaboration of experimental data. Traceability. Introduction to atmospheric and marine chemistry. Global changes: greenhouse effect, stratospheric ozone depletion, radioactive pollution. Local chemical pollution: atmospheric pollution and photochemical smog, coastal marine pollution and petrochemical products. Environmental safety.

Teaching method of the course and assessment method
The course consists of theoretical lectures (4 credits, 36 hours) and laboratory practical work carried out individually (2 credits, 18 hours). The assessment method is an oral examination.

Textbooks
- 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.
- C. Baird, M. Cann. *Chimica Ambientale*, Zanichelli, Bologna, 2006.
- S. E. Manahan. *Chimica dell'Ambiente*, Piccin, 2000.

APPLIED CHEMISTRY FOR ENVIRONMENTAL PROTECTION
(CHIMICA APPLICATA ALLA TUTELA DELL'AMBIENTE)
Prof. Gabriele FAVA

Aims: Understanding the formation and control of air pollutants. Evaluation of the Indor/Outdoor pollution ratio through the knowledge of the pollutant sources. Description of the pricipal control technologies required to improve the air pollution.
Previous Requirements:

1. **Topics:**

1. Classification and extent of air pollution problems. Primary concepts of air pollution. Temporal and spatial scale of air pollution. Urban and Industrial aspects of air pollution. Air quality standards.
2. Primary pollutant sources. The combustion mechanism of pollutants generation. Pollutants emission factors. The motor vehicle problems. Effects of air pollution on the physical properties of atmosphere. Effects on materials and structures.
3. The transport of air pollutants. Meteorological setting for dispersion. Transport and diffusion of stack effluents. The models for plume rise evaluation. Air pollutant concentration models. The Gaussian plume idea. Receptor oriented and source oriented air pollution models.
4. General ideas in air pollution control. The nature of particulate pollutants. Control of primary particulates. Wall collection devices. Gravity settlers. Centrifugal separators. Electrostatic precipitators. Surface filters. Scrubbers for particulate control. Control of volatiles organic compounds (VOC). Adsorption and absorption alternatives.
5. Workplace environmental exposure. Recognition of chemical hazards. Evaluation of hazards. Industrial toxicology. Thresholds limit values (TLV's, MAC) Control of chemical hazards. Industrial ventilation. Indoor air quality. General ventilation. The odour perception.
6. Surface water quality Standards . River pollution. The Streether & Phelps approach.

Textbooks: R.Vismara: Ecologia Applicata, Hoepli. J. H. Seinfeld: Atmospheric Chemistry and Physics of Air Pollution. John Wiley and Sons, A. C. Stern, R. W Bonbel, D.F. Fox : Fundamentals of Air Pollution (II Ed.)Academic Press,1984

COMBINED COURSE:
CHEMISTRY
General Chemistry
(CORSO INTEGRATO: CHIMICA – Chimica Generale)
Dr. Elisabetta GIORGINI

Aims:

At the end of the course, the student will know and will be able to apply the fundamental principles of chemistry, such as nomenclature, molecular structure, acids and bases properties, pH of solution, exchanges of energy, etc.

Previous Requirements:
Basic knowledge of mathematic, physic and chemistry

Topics:
introduction to chemistry. Atomic theory. Atomic mass unit and mole. Atomic structure and Orbitals . Electronic configuration. Periodic table of elements. Nomenclature. Chemical bond. Oxidation number. Chemical reactions. Molecular geometry. Valence bond and molecular orbitals theories. Gas phase. Solid and liquid phases. Thermodynamic and Thermochemistry. Cynetic. Physical equilibria. solutions. Chemical equilibria. Acids and bases. Ionic equilibria in solution. Electrochemistry.

Textbooks:
Masterton Hurley – CHIMICA PRINCIPI E REAZIONI – Piccin
Nobile Mastrorilli – LA CHIMICA DI BASE - Casa Editrice Ambrosiana

COMBINED COURSE:
CHEMISTRY
Organic Chemistry

(CORSO INTEGRATO: CHIMICA – Chimica organica)
Prof. Lucedio GRECI

Aims:
The organic chemistry aims at providing an understanding of all the classes of organic compounds (hydrocarbons and functional compounds), particularly those of major industrial use and with a certain environmental impact. This knowledge has a professional importance.

Previous Requirements:
The course requires the knowledge of General Chemistry

Topics:
Aliphatic and aromatic hydrocarbons. 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. Heterocycles. Photoinduced reactions. Toxic organic compounds.

Textbooks:
HAROLD HART -Chimica Organica - Ed. Zanichelli
JOHN McMURRY - Chimica Organica - Ed. Zanichelli

CONSERVATION OF NATURE AND ITS RESOURCES
(CONSERVAZIONE DELLA NATURA E DELLE SUE RISORSE)
Dr. Antonio PUSCEDDU

Aims:
The course aims at providing the students with the ecological principles of conservation and management of nature and its resources, with a special focus on national methods and criteria and international guidelines for the siting, sizing and sustainable management of protected areas and natural parks

Previous Requirements:
None

Topics:
Introduction to the protection, conservation and management of nature and its resources. Biodiversity conservation principles. Economical and social values of biodiversity. Threatens to biodiversity: loss, vulnerabiliy to extinctions and invasions. Protection, conservation and monitoring of natural habitats;

Protected areas (PA) and parks. PA typologies Selection, creation and siting of PAs; management plans of PAs; Pas zonation Reserve effects. Principles of ecosystem management and restoration

Textbooks:
Primack R.B., Carotenuto L. - **Conservazione della Natura**, **Zanichelli**, 2003

COMBINED COURSE: APPLIED GEOLOGY AND HYDROGEOLOGY: MODULE 1: HYDROGEOLOGY (CORSO INTEGRATO GEOLOGIA APPLICATA ED IDROGEOLOGIA: MODULO 2: IDROGEOLOGIA)

Dr. Paola Maria VIVALDA

Aims: The aim of the course is to give some base elements in the analysis of the hydrogeological resources.

Previous Requirements: Lithology and geology

Topics: Hydrographical basin. Types of aquifers. The data collection in hydrogeology and the discharge measurements. Hydrological balance. Recharge, circulation and emergence of groundwater. The quality of waters. Hydrogeological maps.

Textbooks: P. Celico Elementi di Idrogeologia. Liguori Editore

COMBINED COURSE. APPLIED GEOLOGY AND HYDROGEOLOGY: MODULE 2: APPLIED GEOLOGY (CORSO INTEGRATO GEOLOGIA APPLICATA ED IDROGEOLOGIA :MODULO 1: GEOLOGIA APPLICATA)

Dr. Paola Maria VIVALDA

Aims:
The course gives the methods of acquisition of geological and technical data needed to characterise the territory. The aim of the course is to investigate the principles useful to analyse and solve engineering geological problems in the frame of preservation and management of territory

Previous Requirements:
Geology

Topics:

- Principles of cartography
- Geologic Field Methods. Topographic and geologic mapping methods; measurement and description of stratigraphic sections.
- Introduction to basic soil properties, soil classification, volumetric relationships, compaction, consolidation, soil rheology, shear strength, bearing capacity and lateral stresses against retaining structures.
- **Elements of Engineering Geology.** Application of geologic principles to problems of civil engineering.

Textbooks:
ELVIO LAVAGNA, GUIDO LOCARNO (2007) **-** GEOCARTOGRAFIA, Guida alla lettura delle carte geotopografiche. Zanichelli, Bologna.
COLOMBO P. & COLESELLI F. (1996)- Elementi di Geotecnica. Zanichelli, Bologna.
CANUTI P., CRESCENTI U., FRANCANI V., (2008) – Geologia applicata all'ambiente. Casa Editrice Ambrosiana. Milano.

COMBINED COURSE: CIVIL PROTECTION 1: MODULE 1: THEORY OF DISASTERS (CORSO INTEGRATO PROTEZIONE CIVILE: MODULO 1: TEORIA DEI DISASTRII)

Dr. Fausto MARINCIONI

Aims:
The course deals with the issues connected to the management of emergencies and disasters triggered by extreme events of natural, technological and social origin. Pivotal in the understanding of catastrophic events is the realization that vulnerability and risk are created by an improper use of the natural and technological systems by the humankind. Extreme events of geological, climatic and biological origin, along with technological and social incidents, will be examined from both the physical and socio-economic perspectives. The former will cover the genesis and evolution of extreme events, the latter their impact on the human society and its infrastructures. Finally, current strategies of civil protection to improve safety, forecast, prevention and mitigation of risks, as well as recovery and reconstruction plans will be analyzed in terms of sustainable development.

Previous Requirements:
None

Topics:
The human ecology of disaster
Culture, ethics and disasters
The human-environment interaction: evil nature or bad environmental management?
Natural cycles, extreme events and the socio-economic processes
Hazard, vulnerability, risk, disaster, crisis
Safety, risk and the cost/benefits ratio
Emergency and crisis (the alteration of the normal societal functions)
The spatial and temporal dimension of disasters

Extreme events and their impacts
Energy sources of hazards
Natural, technological and social disasters
Geophysical risks (earthquakes, volcanic eruptions, tsunami, landslides, coastal erosion, subsidence, meteoric impacts)
Climatic risks (tropical cyclones, tornadoes, severe storms, floods, drought, fires)
Biological and ecological risks (epidemics, parasite invasions, extinctions)
Social risks (wars, terrorism, refuges, urban fires, infrastructure collapse)

The human response to disasters
The socio-economic impact
Forecast, prevention and mitigation techniques
Emergency planning and management
Short and long term reconstruction
Land use and urban planning
The lesson of disasters: past, present and future

Textbooks:
Handouts and reading materials distributed in class and available online on the course website.
D.E. Alexander. Calamità Naturali, Pitagora Editrice, Bologna 1990
D:E. Alexander. Natural Disasters. Chapman and Hall, New York, 1993.
F. Santoianni. Protezione civile – Disaster managemement. Emergenza e soccorso: pianificazione e gestione. Accursio Edizioni, Firenze 2007
P. Battipiede, N. Lobosco e G. Dipietro. Protezione civile. Finalità, responsabilità, competenze. Milella Zeditore, Bari 2006

COMBINED COURSE: CIVIL PROTECTION 1:
MODULE 2: CIVIL PROTECTION ORGANIZATION
(CORSO INTEGRATO PROTEZIONE CIVILE: MODULO 2: ORDINAMENTO PROTEZIONE CIVILE)
Dr. Roberto OREFICINI ROSI

Aims:
The course intends to introduce students to the basics of civil protection; its organization, the essential activities, the different typologies of hazards, the available technologies and the planning strategies.

Previous Requirements:
None

Topics:
The definition of disasters. The evolution of the civil protection. Civil defence versus civil protection. Scope and activities of civil protection. The components of the civil protection system. First rescue and the different types of emergencies. Emergency plans and their design. The cOre risks: seismic, idro-geological, volcanic, industrial, forest fires, public health and technological risks (e.g. aeronautical and nautical transportations). The non-conventional risks. The mass emergencies and large extreme events. The logistics of civil protection. The communication systems. Psychology of disasters and institutional communication. The voluntary service. Field exercises and scenario.

Textbooks:
Pompeo Camero: **Manuale tecnico giuridico di protezione civile e di difesa civile**, Maggiòli Editore".

APPLIED ECOTECHNOLOGY (ECOTECNOLOGIE APPLICATE) Dr. Antonio DELL'ANNO

Aims:
The course provides the students with the basic knowledge for planning interventions for the reduction of anthropogenic impact on natural ecosystems and on principles and advanced technologies applied for the environmental recovery and restoration

Topics:
Basic principles for quality assessment, management and restoration of ecosystems; planning ecosystem remediation and restoration; in situ and ex situ technologies for environmental remediation; separation, transformation and immobilization processes of contaminants; chemical, physical and biological technologies; *biostimulation*, *bioagumentation*, kinetic models for assessing bioremediation performance; biotechnological applications in environmental remediation and restoration; use of microbial mats for environmental remediation and restoration; identification and containment of oil spills; treatments for biofouling containment; basic principles of biological wastewater treatment; sludge biotic index; sludge treatment and reuse; phytoremediation; principles for the treatment and management of solid wastes.

Textbooks:
Duplicated lecture notes
R. Danovaro, Recupero ambientale: tecnologie bioremediation e biotecnologie, UTET, 2001.
Enitecnologie Agippetroli, La bonifica biologica di siti inquinati da idrocarburi, Hoepli, 2001.
Hinchee, R. E. et alii, Applied Biotechnology for Site Remediation, Lewis Publishers Inc., 1994.
Vismara R, Depurazione biologica, teoria e processi, Hoepli, 2001.
Grillo N. G, Trattamento delle acque reflue. La fitodepurazione, Geva, 2003.

ECOTOXICOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT (ECOTOSSICOLOGIA E VALUTAZIONE IMPATTO AMBIENTALE) Prof. Francesco REGOLI

Aims:
The Course of Ecotoxicology and Environmental Impact Assessment is aimed to prepare students for the study of environmental pollution, with particular emphasis to the toxicological implications of chemicals on various biotic components. The course will also aim to prepare students will on quality standards, the integrated complexity between development of productive activities and environmental protection, management options and environmental impact assessment, remediation and monitoring of polluted areas. The course is based on both theoretical lessons and practical exercitations on the main chemical contaminants, their environmental distribution and biological effects, bioindicator organisms, molecular and cellular responses to pollutants. The course will also prepare students on normative guidelines and environmental impact assessment, general and economical issues in the use and preservation of resources, industrial risks and dangerous substances. Conflicting interests will be addressed with examples for urban traffic, electromagnetic fields, activities related to management and development of harbour areas, dredging and disposal of sediments, remediation of polluted areas, coastal erosion and use of sediments. Practical examples will include guidelines, management strategies, technical applications and sampling strategies. At the end of the Course the student should have the capability to: 1. Describe main characteristics of chemicals and environmental distribution pathways. 2. Know topics related to biomagnification, use of

bioindicator organisms and biomarker analyses. 3. Describe fundamentals and general principles of environmental impact assessment in industrialized and developing countries. 4. Apply conceptual criteria for defining quality criteria in different environmental matrices. 5. Apply criteria for environmental impact of atmospheric pollution, electromagnetic exposure, vehicular traffic, management of coastal areas, dredging, remediation and coastal erosion.

Previous Requirements:
A good knowledge of basic chemistry, ecology, general and cell biology are important requisites for this course.

Topics:
The Course of Ecotoxicology is based on both theoretical lessons and practical exercitations.
Lessons 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 damages 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 applications.
During the practical exercitations students will plan a monitoring program, with the choice of more appropriate species and biomarkers. The main methodologies will be presented and measured, including a brief discussion of obtained results.

Textbooks:
Provided material and scientific literature suggested on specific topics.
Fundamentals of Aquatic Toxicology. Edited by Gary M. Rand, Taylor & Francis 1995
Biomarkers in Marine Organisms: a practical approach. Edited by Garrigues et al., Elsevier 2001
Dragaggi Portuali – Aspetti Tecnico Scientifici per la salvaguardia ambientale nelle attività di movimentazione dei fondali marini. Pellegrini et al., Quaderni ICRAM

SANITARY EMERGENCIES
(EMERGENZE SANITARIE)
Dr. Erica ADRARIO

Occurring a catastrophe or a collective accident determines more or less precise and quick answer from the collectivity: the aid
This answer can vary in form and intensity relating to the gravity of the consequences on the environment, but it always must be a sanitary answer since the amplitude of the material damages is augmented by the presence of victims.
After occurring a catastrophe, the organization of the sanitary aid has to be integrated in the widest context of the global organization of the aids . That consists in a certain number of different interventions, involving experts of different activities, whose objective is permitting the execution of the sanitary aid .
The whole operations is developed on the base of:
1. making quickly stop of the danger assuring the recovery of the victims:
rescue
2. realizing a certain number of actions allowing the medical unities to take care of the victims :
aid assistance

Aims:
The course intends to furnish the student the essential elements and the knowledges about the organization of the aids during natural (or not) calamity , tactical and logistic aspects about the organization of the materials, as well as base techniques of the activation of the aid chain.
Practical training of cardiopulmonary reanimation on manikin will be performed .

Topics:

The answer to the catastrophe
Organization of the aids
Tactical and logistic aspects
Rescue Personnel
Structures and their functioning
Evacuation
Basic Aid Techniques
Triage
Actual Aid in Italy : state of the art
BLSd

Textbooks:
R.Noto, P.Huguenard, A.Larcan :Medicina delle catastrofi- Masson
IRC:BLS-D,basic life support, early defibrillation. 5° ed.
M.Chiaranda:Urgenze ed Emergenze-Istituzioni- Piccin

PHYSICS
(FISICA)
Dr. Francesco SPINOZZI

Aims:
The present course in Physics is concerned with the study of matter, energy, forces, and their interaction in the world and universe around us. The present curriculum includes 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. The course will provide the student with the necessary competences on the physical basic laws and concepts (both theoretical and experimental) to study and to understand the physical properties of the biological matter in the frame of the life and environmental sciences.

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

Topics:
Introduction to Physics. Physical values, measurements, units and standards. Kinematic of material point. Dynamic of material point. Kinematic of rigid body. Dynamic 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 field.

Textbooks:
- Giambattista, Richardson & Richardson, "College Physics", Second edition, McGraw-Hill, 2007.

ENVIRONMENTAL TECHNICAL PHYSICS
(FISICA TECNICA AMBIENTALE)
Prof. Paolo PRINCIPI

Previous Requirements: taken the exam of physics

Topics:

HEAT AND MASS TRANSFER

The importance of heat transfer, the fundamental concepts and the basic modes of heat transfer. The Fourier low of conduction and the general heat conduction equation. The thermal conductivity.

Steady state heat conduction in one dimension. The fundamental low of convection, The Newton low the boundary layer concept. Forced convection and natural convection. Heat transfer by radiation, the Stefan-Boltzmann low, black body radiation, Radiation from real surfaces and ideal grey surfaces. Combined heat transfer. Heat loss calculation between indoors and outdoors in a building.

THERMODYNAMICS

The calculation of condensation risk, vapour resistivity, surface and interstitial condensation. Thermal comfort. Reversed Cycles, the reversed Carnot Cycle, Unit for refrigerating effect. Two phase systems of a pure substances, Thermodynamic surface in p,v,T coordinates. Heat and moisture air, composition of air, the use of psychrometric chart .

ENVIRONMENTAL CRITERIA
The calculation of condensation risk, vapour resistivity, surface and interstitial condensation.
Thermal comfort.
Renewable energies and their use, solar energy, active and passive solar systems, solar flat collector, FV, wind energy, biomass, geothermal energy.

Textbooks:

- Çengel Y.A., Termodinamica e Trasmissione del Calore - seconda edizione, McGraw-Hill Companies srl, Milano, 2005.

FUNDAMENTALS OF BIOLOGY: (FONDAMENTI DI BIOLOGIA)

Dr. Adriana CANAPA

Aims:
This course deals with the basal aspects of the organisation and function of Eukaryotic and Prokaryotic cells and of the mechanisms of the transmission of hereditary characters

Previous Requirements:
Knowledge at the level of secondary school of the first elements of physics, chemistry and genetic.

Topics:
General properties of the living organisms, cellular membranes; cytoplasmic organelles; nucleus; chromosomes; mitosis; meiosis; the Mendel's laws of the transmission of the hereditary characters.

Textbooks:
Chieffi et al. Biologia & Genetica. Edises; Colombo R., Olmo E. Biologia della cellula. Edi-ermes

FUNDAMENTALS OF METEOROLOGY AND CLIMATOLOGY (FONDAMENTI DI CLIMATOLOGIA E METEOROLOGIA)

Prof. Pierpaolo FALCO

Aims: The course is aimed to provide students with the knowledge regarding the basic laws which determine the processes and the dynamic of the atmosphere. This point represents the base to understand of :

1) the processes occurring along the vertical direction
2) the processes occurring on the horizontal plane
3) the general atmospheric circulation
4) the evolution of weather conditions in the boundary layer
5) the state of the past and preset climate conditions, of the climate variability and of the main phenomena which determines the climate on large scale.

Previous Requirements: physic and mathematic course are necessary to attend the class

Topics:

Atmosphere: introduction; thermodynamic state; pressure ; density; temperature, ideal gas laws; isometric equation; atmosphere structure and terminology.
Radiation : orbital factors; fluxes; radiation laws.
Heat: sensible and latent heat; lagrangian heat budget (not saturated atmosphere; first thermodynamics law; adiabatic and thermal environmental gradient; potential temperature; thermodynamics diagrams); eulerian heat budget (advection; conductivity and surface fluxes); turbulence; radiation; latent heat; net heat budget; surface heat budget; apparent temperature. Temperature measurements.
Boundary Layer: static stability; boundary layer set up; structure and evolution; air pollution in the boundary layer.
Humidity: water vapour saturation pressure; variables; mixing ratio; eulerian budget; lagrangian heat budget (saturated adiabatic gradient; thermodynamics diagrams; equivalent potential temperature). Humidity measurements.
Stability: thermodynamic diagrams (applications); buoyancy; static stability; thermodynamics diagrams for the boundary layer; Brunt-Väisäla frequency; dynamic stability.
Cloud Formation: development and size; saturation processes; fogs
Precipitation: Raindrops and ice crystals formation; growth of raindrops and ice crystals by diffusion; collisions and collections; condition for raindrops falling, estimates of precipitation by radar and precipitation measurements.
Dynamic: scales; wind velocity; vertical equation of the motion; thermal circulation; streamlines and streaklines; trajectories; Bernoulli equation; the geostrophic approximation; topographic wave; foehn; wind measurement;
Global circulation: nomenclature; differential heating; thermal wind; jet stream; vorticity; jet stream meandering; general circulation (Ferrel and Hadley cells); Ekman spiral.
Air masses and fronts :Anticyclones; air masses; synoptic charts, surface fronts; fronts formation; fronts in intermediate and upper atmosphere.
Climate and its classification: Introduction; classification methods, climate typology; history of the world climate.
Variability of the climatic system: moderate and quickly transformation; current climatic transformation; signals and effects; Italian climate; air-sea interactions; Teleconnections; the El Niño-Southern Oscillation (ENSO); the North Atlantic Oscillation (NAO); inter-decadal fluctuations and trends

Textbooks: John M. Wallace e Peter V. Hobbs, Atmospheric Science: An Introductory Survey (International Geophysics)**,** Academic Press

GEOLOGY
(GEOLOGIA)
Prof. Massimo SARTI

GENERAL GEOLOGY

- Interior of the Earth. Crust, mantle, nucleus, Mohorovicic discontinuity. Lithoshere and astenosphere. 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, palaeontolological 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. Plane 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

- 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 eteropy. Concept of facies. Principle of Walther and its applications.

Recommended textbooks:
1) Haq B.U. and Boersma A. Eds.: Introduction to marine Micropaleontology (1980) 2) Seibold E. & Berger W.H.: The sea floor. An introduction to Marine Geology (1982) 3) Lipps Jere H.: Fossil Prokaryotes and Protists Blackwell Scientific Publications 1993 4) Brenchley P.J. & Harper D.A.T. Paleoecology, Chapman & Hall 1998.

MATHEMATICAL AND STATISTICAL METHODS (METODI MATEMATICI E STATISTICI)

Dr. Milena PETRINI

Aims: Fundamentals of differential and integral calculus. Knowledge of most important models of biological populations' dynamics. Introduction to probability, basic statistics and statistical inference.

Previous Requirements: Fundamentals of Calculus and Analitical Geometry.

Topics: Numerical sets and real functions: basic functions; growth of a bacterial population.
Limit of real sequences and series : standard limits; geometrical serie.
Function' limit and continuity: continuous functions and related theorems.
Derivative and applications to functions' study.
Integrals: definite and indefinite of a countinuous function; integration' methods. **Differential equations:** linear first order differential equations, Bernoulli's d. e.; some elements of constant coefficients second order d.e.; mathematical models of population dynamics.
Complements of calculus and linear algebra.
Descriptive statistics: linear regression and least squares correlation coefficient and matrix. **Probability:** probability space; simple and conditional probability of events.
Bernoulli's and Poisson's laws; exponential and normal density.
Inferential statistics: Bayes' formula and consequences; problems with parameter; likelihood function, parameter's estimation. Error estimate.

Textbooks:
Marcellini - Sbordone, *Istituzioni di Matematica e Applicazioni,* Liguori Editore.
P. Baldi, Introduzione alla probabilità. Con elementi di statistica*,* Mc Graw-Hill Editore.
G. Prodi, *Metodi matematici e statistici*, Mc Graw-Hill Editore.
Marcellini - Sbordone, *Esercitazioni di Matematica*, Vol. 1, 2, Liguori Editore.

ENVIRONMENTAL MICROBIOLOGY (MICROBIOLOGIA AMBIENTALE)
Prof. Maurizio CIANI

Aims: The aim of the course is to give the basic knowledge to understand the role of micro-organisms in the environment and their involvement on bioremediation.

Previous Requirements:
Biology, Biochemistry

Topics:
Prokaryotes and eukaryotes: principles of microbial nutrition and metabolism. Microbial techniques: microscopy, media for microorganisms cultivation, sterilization techniques, techniques for microorganisms cultivation. Microbial ecology: methodological approach to study microorganisms in the environment (samples, isolation enrichment procedures, identification). Cultivable and uncultivable microorganisms. Metabolic diversity in the microbial word: phototrophic, chemiolitotrophy, anaerobic respiration, fermentation, hydrocarbon oxidation and the role of molecular O_2 in the catabolism of organic compounds, nitrogen fissation) Microbial growth. Bio-geochemical cycles :carbon, nitrogen, sulphur. Processes and principal microbial groups involved.

Role of micro-organisms in the bioremediation of contaminated sites

Textbooks:
Biavati, Sorlini Microbiologia agroambientale CEA Ambrosiana, 2008
Madigan, Martinko, “Brock biologia dei microrganismi” Vol. 1 2° CEA Ambrosiana, 2007

FORECASTING AND PREVENTION OF NATURAL DISASTERS
(PREVISIONE E PREVENZIONE CATASTROFI NATURALI)
Dr. Maurizio FERRETTI

Aims: basic knowledge for risk forecast and management

Previous Requirements: meteorological and geological courses

Topics:

Operative chain for hydrogeological risk forecast
Nowcasting : meteorological satellite and radar
Forecast numerical models: global circulation and limited area models
Meteorological maps interpretation

Landslide Risk.
Marche geological overview
Landslide triggering factors: case studies
Precipitation amount and related landslide investigation for forecast soil effects
Triggering rainfall thresholds

Landslide forecast models: physical based and empirical models
Italian case studies
CF Marche activities

Hydraulic risk
Rainfall-Runoff process
Temporal and spatial scale
Rainfall spatial estimation methods
Precipitation data analysis and precipitation intensity-duration curves
Hydrological modelling
Rainfall thresholds definition for runoff scenarios
Hydraulic modelling introduction

Fire risk
Integrated telecontrol and monitoring systems
Risk management. Fire extinguishing activities.
Planning and prevention

Sismic risk.
Seismogenesis
Seismological precursors
Monitoring system and data dissemination
Prevention
Case studies and hazard scenarios

Volcanic risk.
Volcanology
Volcanic precursors
Prevention
Case studies and hazard scenarios

Textbooks:

Rosso Renzo, Manuale di protezione idraulica del territorio. Appendice sulla normativa italiana in materia di difesa del suolo, protezione civile e dighe, CUSL (Milano) (collana Scientifica);

ENVIRONMENTAL RECOVERY TECHNIQUES
(TECNICHE DI BONIFICA AMBIENTALE)
Dr. Francesca BEOLCHINI

Aims: At the end of the course the student will be able to manage main processes for wastewater treatment and contaminated soil bioremediation.

Previous Requirements: none

Topics: *Basic skills*. Material balances. Theoretical models for reactors. *Wastewater treatment.* Primary treatments. Biological processes for organic carbon degradation. Nitrification. Denitrification. Nitrification/Denitrification. Biological phosphorous removal. Suspended biomass activated sludge process. Fixed biomass processes. Control parameters for such processes. *Water treatment for Civil Protection*. Disinfection. Potabilisation. *Soil bioremediation*. In situ and ex situ technologies. Bioventing. Slurry bioreactor. Control parameters for such processes.

Textbooks:
Metcalf & Eddy, 1991. Wastewater engineering: treatment, disposal, reuse. McGraw Hill.
EPA/540/R-95/534a. Bioventing principles and practice. Environmental Protection Development September 1995

APPLIED ZOOLOGY
(ZOOLOGIA APPLICATA)
Prof. Giorgio BAVESTRELLO

Aims:
Aim of this course is to provide both theoretical and practical knowledge about the use of animal organisms as bio-indicators of pollution for the study of aquatic ecosystems (both in fresh and marine waters), the soil and the efficiency of depuration plants.
A part of the course will be devoted to the study of the ecology of urban fauna.

Previous Requirements:
Good zoological knowledge

Topics:
Animals as indicators
Main groups of animals used as indicators
Biotic indexes for fresh and marine waters
Techniques of collection of benthic organisms
Techniques of observation and counting
Micro fauna involved in the depuration processes
Techniques of microscopy
Techniques of counting and identification.
The SBI index and its applications.
Management of urban faunas

Textbooks:
Pamphlets provided by the teacher

POSTGRADUATE PROGRAM
APPLIED BIOLOGY
ACADEMIC YEAR 2009/2010
CLASS LM-6
COURSE CONTENTS

BIOCHEMICAL ANALYSIS
(ANALISI BIOCHIMICHE)
Dr. Elisabetta DAMIANI

Aims:
At the end of the course, students will have achieved an overall knowledge on the fundamental points necessary for understanding and carrying out the most common laboratory tests. Students will reach this goal through basic lectures on certain analytical methods, on laboratory tests and their general significance regarding the characterization and qualitative and quantitative determination of the principal classes of biomolecules of particular interest for basic research and biomedical diagnostics. This goal will be reached even through laboratory practicals. In addition, students will have gained a basic understanding of free radicals and antioxidants, their role in biological systems and the different methods used for investigating them.

Previous Requirements:
Basic knowledge in Biochemistry and Human Anatomy is desirable.

Topics:
Withdrawal, conservation and elimination of biological samples. Quality control in an analysis laboratory. Qualitative and quantitative analyses of the most important enzymes and isoenzymes present in tissues and biological liquids. Luminescence and its analytical applications. Acid-Base equilibrium of blood. General information on plasma proteins and their separation, characterization and determination. Physical, chemical and microscopic analysis of urine. Analyses of the principal biochemical constituents involved in carbohydrate and lipid metabolisms. Classification, separation and analysis of plasma lipoproteins. Tumour markers. Routine hematology. Blood groups. Metabolism of bile pigments. Role of free radicals and antioxidants in biological systems.

Textbooks: At the end of each topic, handouts and powerpoint slides will be distributed by the lecturer.

CHEMICAL ANALYSIS OF FOODS
(ANALISI CHIMICHE DEGLI ALIMENTI)
Dr. Cristina TRUZZI

Aims:
Knowledge of the fundamentals of main chemical analytical techniques applied in the field of food analysis, with examples concerning the principal groups of foods/beverages and the most important chemical determinations (from a nutritional point of view or with the aim of checking for the presence of undesired substances).

Previous Requirements:
Knowledge of the topics of the courses on General and inorganic chemistry, Organic chemistry, Instrumental analytical chemistry.

Topics:
Generality on food sample collection and treatment. Laboratory techniques and classic and instrumental analytical methodologies application for food analysis. Chemical analyses of main food groups both from animal and plant origin (meat, eggs, fish, milk, honey, vegetables, fruits). Analysis of beverages. Determination of the main substances of nutritional importance and of general characterization (e.g. water, dry residue, ashes, nitrogen from protein and non protein origin, sugars, fats, acidity, vitamins). Determination of contaminants (e.g. pesticide residues, polycyclic aromatic hydrocarbons, polychlorobiphenyls, toxic metals).

Textbooks:

- Copy of slides available
- D. Marini, F. Balestrieri: *Metodi di analisi chimica dei prodotti alimentari*, Monolite Editrice, Roma, 2005.
- S. Mannino, MG Bianco: *Esercitazioni di analisi chimica dei prodotti alimentari - esperimenti pratici di laboratorio*, Tecnos Editrice, Milano, 1996.
- P. Cappelli, V. Vannucchi: *Chimica degli alimenti – Conservazione e trasformazioni*, Zanichelli, Bologna, 2005.
- F. Tateo: *Analisi dei prodotti alimentari*, Chiriotti Editore, Pinerolo, 1978.

BACTERIAL PATHOGENS
(BATTERIOLOGIA SPECIALE)
Prof. Eleonora Giovanetti

Aims:
At the end of the course the student should have acquired knowledge about interactions between humans and prokaryotic microorganisms, with special emphasis on implications for human health. The student should also be acquainted with the characteristics of bacterial genera and species involved in human infections and with the basic laboratory methods for bacterial identification.

Previous Requirements:
Knowledge of General Microbiology and General Bacteriology is required.

Topics:
Microorganism-host interactions; bacterial pathogenetic mechanisms; virulence determinants; routes of transmission of bacterial agents. Principles of epidemiology. Typing methods.
Major groups of bacteria involved in human pathology: staphylococci, streptococci, enterococci, *Neisseria*, *Listeria*, *Bacillus*, *Corynebacterium*, mycobacteria, *Enterobatteriaceae*, *Vibrio*, *Campylobacter*, *Helicobacter*, *Pseudomonas* and other nonfermentative Gram-negative bacteria, *Brucella*, *Haemophilus*, *Bordetella*, *Clostridium*, *Bacteroides*; spirochetes, mycoplasmas, chlamydiae and rickettsiae.

Textbooks:
- M. Bendinelli, C. Chezzi, G. Dettori, N. Manca, G. Morace, L. Polonelli, M.A. Tufano, “Batteriologia”, Monduzzi Editore.
- G. Antonelli, M. Clementi, G. Pozzi, G.M. Rossolini. “Principi di Microbiologia Medica”, Casa Editrice Ambrosiana.

FOOD BIOCHEMISTRY
(BIOCHIMICA DEGLI ALIMENTI)
Dr. Tiziana BACCHETTI

Aims:
Give students the tools to know:
- the main nutritional compounds in food and the reactions in which they are involved during food. processing and storage.
- the biochemical mechanisms that regulate digestion, absorption and metabolic utilization of nutrients
- the molecular basis of the main diseases associated with wrong eating habits.

Previous Requirements:
Basic biochemistry knowledge

Topics:
F*ood and Nutrition*
Food and nutritional characteristics
-Food Carbohydrates: monosaccharides, disaccharides, oligosaccharides, polysaccarides, non-starch polysaccarides, vegetable fiber, artificial and non-carbohydrate sweeteners, prebiotics and probiotics.
- Food Lipids, fatty acids (saturated, unsaturated, essential fatty acids), hydrogenation and vegetable oils, lipid peroxidation, animal and vegetable sterols
-Food Proteins, proteolytic enzymes, evaluation of protein quality
-Vitamins and their physiological importance

- Phytonutrients and their physiological functions
- Alcoholic beverages
- Minerals
- Food additives and flavourings

Alterations during food processing

Maillard reaction, non-enzymatic browning reaction and nutritional effects. Fatty acids hydrogenation and lipid peroxidation. Protein degradation.

Food and health

Textbooks:

Paolo Cabras , Aldo Martelli. "Chimica degli alimenti" Ed.Piccin-Nuova Libraria
Ivo Cozzani, Enrico Dainese "Biochmica degli Alimenti e della Nutrizione" Ed. Piccin-Nuova Libraria
Costantini, Cannella, Tomassi. "Fondamenti di Nutrizione Umana " Ed.Pensiero scientifico

APPLIED AND INDUSTRIAL BIOCHEMISTRY
(BIOCHIMICA APPLICATA E INDUSTRIALE)
Prof. Fabio TANFANI

Aims:

The first objective of the course is to teach the student on the techniques concerning the structural-functional characterization of proteins and complex biological systems. The second aim of the course is to give information on the strategies for the preparation and purification of proteins at industrial level and on the use of enzymes and proteins in the food, pharmaceutical and chemical industries.

Previous Requirements:

Knowledge in Chemistry and Biochemistry.

Topics:

Cells as factories for the production of proteins and secondary metabolites.
Homogenization of tissues and cells on a laboratory and industrial scale. Main chromatographic techniques for the purification of proteins on a laboratory and industrial scale.

Spectroscopic and radioisotopic techniques:
Fundamentals and uses of fluorescence, infrared, and circular dichroism spectroscopy in the study of biological systems. Radioisotopes, labelling of proteins and polynucleotides, detection and measurement of radioactivity in biological systems.

Immunochemical techniques:
Polyclonal and monoclonal antibodies, immunoprecipitation, immunodiffusion and immuno electrophoresis techniques. Immunoassays.

Sources for the extraction of proteins of industrial interest.
Purification strategies applied to industrial, therapeutic and analytical proteins. Proteins from animals, plants, and from mesophile and extremophile organisms. Protein production from genetically engineered organisms. Protein post-translational modification. Storage of biocatalysts.
Purification of exocellular and endocellular proteins. Scale-up of the protein extraction and purification process. Proteins as inclusion bodies: solubilization and refolding methods. Technical and economical implications in the choice of a strategy for protein purification.

Proteins and enzymes for industrial applications.
Immobilized enzymes, immobilization techniques, bioreactors.
Proteases: classification and industrial uses. Carbohydrases: applications of alpha-amylase, beta-amylase, glucoamylase, alpha-(1-6) glucosidase, and glucose isomerase. Enzymes able to hydrolize cellulose, emicellulose, and pectin. Lipases and their applications. Milk proteins. Enzymes and proteins for medical, pharmacological, analytical, and food applications. Microbial, viral, pyrogenic and protein contaminants. Biosensors: principles and applications.

Textbooks:

1) Keith Wilson & John Walzer (Eds.), Principles and Techniques of Practical Biochemistry, Cambridge University Press, 2000.
2) Gary Walsh. Proteins, Biochemistry and Biotechnology. John Wiley and Sons, LTD

3) Adrie J.J. Straathof and Patrick Adlercreutz (Edts.) Applied Biocatalysis. Harwood Academic Publishers

BIOPHARMACOLOGY
(BIOFARMACOLOGIA)
Dott. Lamberto RE

Aims:
The course is established to widen the knowledge in clinical pharmacological field with particular reference to the basic notions during the Course of Pharmacology. The purpose will be that to furnish useful elements for the formation of specialized professional figures devoted to the scientific information in the medicinal field. The treated matters will be fundamental besides for professional results in firms of the pharmaceutical sector, with particular respect to the field of the ethno-botanic and to the homeopathy.

Previous Requirements:
Suitable knowledge of general physiology, neurochemistry and biochemistry.

Topics:
Definition of receptor, agonist and antagonists. Molecular mechanisms at the base of the pharmacological action: constant of affinity, equipotent dose 50, curves dose effect and principles of the law of action of mass. Pharmacokinetics and formality of administration of the medicines. Calculation of the plasmatic half-life and volume of distribution. Function of the principal pharmacological receptors: adrenergic and cholinergic. Concept of synapses and nicotinic receptors.
Legislation on the drug marketing. Notes on the dietary supplements, homeopathic medicines, cosmetic medicines and natural derived drugs. Methods of epidemiological evaluation on the drug action: pre-clinic phases, randomized studies, post-marketing pharmaco-vigilance. Symptomatic and etiologic drugs, interactions among medicines. Therapeutic approaches and dosages: antibiotic, antiviral, cardiovascular. Medicines of the peripheral nervous system and of the central nervous system: neuromuscular, anaesthetic and psychotropic drugs. Anti-inflammatory, hormones.
Adverse drug reactions (ADR's), abuse of medicines and pharmaco-dependence, toxicology, prescription. Notes of complementary therapies to the pharmacological treatment (CAM): Homeopathy, Naturopathy, Oxygen-Ozone Therapy, Biological Medicine.

Textbooks:
Goodman and Gilman, Zanichelli;
Farmacologia e Terapia Medica, Kalant Roschlau, Casa Editrice Ambrosiana;
Lessons of the Courses..

MOLECULAR BIOPHYSICS
(BIOFISICA MOLECOLARE)
Dr. Francesco SPINOZZI

Aims:
The students of the course will gain a relative competence in the application of the principles of Physics and Biology that underlay on a molecular level phenomena in the living systems. A basic knowledge of the structural and functional aspects of biomolecules and biological membranes and of the methodologies of the molecular biophysics will be acquired.

Previous Requirements:
Students are expected to have had basic courses in physics, chemistry, biochemistry and biology.

Topics:
Concepts of thermodynamics: free energy and chemical potential; Thermodynamic probability and entropy; Concepts of statistical thermodynamics; Concepts of quantum mechanics; Geometry of a polymeric chain; Some fundamentals of electrostatics; Intermolecular forces; The structure of the water, hydration effects; Hydrophobic and hydrophilic molecules; Hydration of proteins; Debye-Hückel theory; Monte Carlo method; Molecular Dynamics method.

Textbooks:
- R. Glaser, Biophysics, Springer
- K.E. van Holde, W.C. Johnson, P.S. Ho, Principles of Physical Biochemistry, Prentice Hall.
- M. Daune, Molecular Biophysics, Oxford University Press.

CHEMICAL BIOLOGY
(BIOLOGIA CHIMICA)
Prof. Mario ORENA

Aims: Upon completion of this course, the student is able to understand the mode of action of significant peptidomimetics and can identify some relevant mimetics of nucleic acids.

Previous Requirements: basic understanding of the principles of organic chemistry and enzymatic transformations.

Topics:

1. Mimetics of endogeneous peptides with increased stability and biological activity. Agonists and antagonists of peptide ligands. Peptidomimetics can be enzyme inhibitors as mimics of transition states. Freidinger lactams: properties and synthesis. De novo design of pseudopeptides and peptidomimetics. Dolastatins and their synthetic analogues. The Freidinger lactams: structural properties and synthetic approaches.. Leu- and Met-encephalins and the morphine isosteres as conformationally restricted mimetics with enhanced biological activity. The RGD sequence and its mimetics in interactions towards integrins: applications in therapy and in building up of biocompatible structures. Anesthetic peptides from Conus. Peptide toxins from marine organisms directed at potassium channels.
2. Peptidonucleic acids: structure, synthesis and activity
3. Conformationally restricted nucleic acids

Textbooks: P.M. Dewick, Medicinal Natural Products, Wiley, 2004

MOLECULAR BIOLOGY II
(BIOLOGIA MOLECOLARE II)

Prof. Anna LA TEANA

Aims:
The aim of the course is to allow the students to acquire basic information concerning molecular mechanisms involved in the regulation of gene expression at the different levels with a special interest in all post-transcriptional events. In addition, some of the experimental approaches most widely used for gene expression analysis will be described.

Previous Requirements:
Molecular Biology, Genetic Engineering

Topics:
Overview of the mechanisms for gene expression regulation
Examples of regulation at different levels:
- transcription
- post-transcriptional events
- mRNA stability
- mRNA processing
- alternative splicing
- translation
- protein splicing

Methods for gene expression analysis:
- analysis of nucleic acids-protein and protein-protein interactions
- analysis of promoters, reporter genes
- DNA microarrays

Textbooks:
Selected articles from the main Molecular Biology journals are provided during the course

BIOTECHNOLOGY OF MICROORGANISMS

(BIOTECNOLOGIA DEI MICROORGANISMI)
Prof. Maurizio CIANI

Aims:
Il corso ha lo scopo di fornire le conoscenze di base sui microrganismi e sulle loro modalità d'impiego nei processi biotecnologici
The aim of the course is to give the basis knowledge on microorganisms and their use in biotechnological processes
Previous Requirements:
General Microbiology, Biochemistry
Topics:
Introduction: general arrangement and sectors of application; micro-organisms and products of industrial fermentations. Micro-organisms and biotechnological processes. Taxonomic and systematic arrangement of microorganisms of use or potential use in the fermentation processes; Bacteria, yeasts, filamentous fungi.
Microbial metabolism: main pathways of carbon and nitrogen metabolism and its regulations; Screening and selection of industrial cultures; genetic manipulations of industrial strains; The conservation of microbial cultures: the Collections of microorganisms. The metabolism of carbon and nitrogen and the respiro-fermentative metabolism of yeasts; . The aerobic and anaerobic fermentations, primary and secondary metabolites, heterologous proteins.
Methods for microbial cultivation. Growth kinetic of biomass in batch culture. Biomass growth: batch, fed-batch, extended batch, batch with cell recycle, continuous culture; kinetic of microbial growth and fermentation products; principal parameters of fermentation process.
Bioengineering Bioreactors: agitation and aeration technology, (oxygen transfer); measurements and regulations of principal fermentation parameters; fermentation plant (fundamental and auxiliary equipments, modality of sterilization. Product recovery of biotechnological processes
Immobilization of enzymes and micro-organisms. Industrial application of immobilized enzymes and micro-organisms.

Textbooks:
M. Manzoni Microbiologia Industriale CEA Editrice 2006
Donadio, S., Marino, G. Biotecnologie microbiche CEA Editrice 2008

CELLULAR BIOTECHNOLOGY
(BIOTECNOLOGIE CELLULARI)
Dr. Adriana CANAPA

Aims:
After the course basic knowledge and information regarding the most common procedures adopted to culture eukaryotic cells in vitro and to manipulate them genetically for medical and industrial applications will be learnt by the students.

Previous Requirements:
Knowledge of basal concepts of cytology and histology, genetic and molecular biology

Topics:
Objectives and instruments of cell biotechnologies. Cell and tissue cultures. Stem cells technologies. Tissue engineering for clinical applications. Recombinant DNA
Technology. Generation of recombinant proteins in eukaryotic cells. Transgenic animals and cloning by transfer of the nucleus. Gene therapy applied to man. Cell biotechnology applications in the various fields. Regulations and patents.

Textbooks:
Paola Defilippi e Guido Tarone, Colture cellulari -Tecniche di base- Collana I manuali delle scuole Ph.D.04,
Click B.R. and Pasternak J.J., Biotecnologia molecolare, Zanichelli,

CHEMISTRY OF SECONDARY METHABOLISM
(CHIMICA DEL METABOLISMO SECONDARIO)
Prof, Mario ORENA

Aims: Upon completion of this course, the student should be able to identify products arising from significant methabolic pathways and appreciate and explain the mechanistic pathways leading to bioactive products.

Previous Requirements: basic understanding of the principles of organic chemistry and enzymatic transformations.

Topics: 1. Secondary methabolism as source of pharmacologically relevant products. Structure-activity relationships. Acetyl-CoA as starting unit. Macrolide antibiotics with antibacterial and antimutagenic activity: erythromycin, adriamycin and epothilone. The tetracyclins. Coloured compounds from flowers: chromans, chromenes, flavenes and flavonoids. From arachidonic acid to prostaglandins and their derivatives. Another approach to the aromatic system: the shikimic acid pathway.

2. The C-5 unit: significant examples of monoterpenes, diterpenes and triterpenes as components of essential oils, precursors of Vitamin A and carotenes. Cannabinoids: tetrahydrocannabinol and his analogs. The natural steroids and their synthetic analogues. The sapogenis from Dioscorea. Relationships occurring between steroidal strucures and their biological activities.

3. Classes of alkaloids: ornitine, lysine, tyrosine, histidine and triptophan as amino acids precursors of alkaloids. Alkaloids from nicotinic acid. Anti-mutagenic alkaloids: vinblastin and vincrystin.

Textbooks: P.M. Dewick MEDICINAL NATURAL PRODUCTS Wiley-VCH Verlag,, Weinheim (D), 2005.

BIOACTIVE HETEROCYCLIC COMPOUNDS
(COMPOSTI ETEROCICLICI BIOATTIVI)
Dott. Giovanna MOBBILI

Aims: General knowledge of principal heterocyclic compounds action mechanism and ability to apply this knowledge to the field of bioactive molecules.

Previous Requirements: General Chemistry, Organic Chemistry

Topics: Nomenclature and reactivity of principal oxygen, nitrogen, sulphur saturated and aromatic heterocyclic compounds
Alkaloids. Alkaloids derived from ornithine. Alkaloids derived from lysine. Alkaloids derived from nicotinic acid. Alkaloids derived from tyrosine. Alkaloids derived from tryptophan. Alkaloids derived from histidine. Alkaloids derived from acetate. Purinic alkaloids.
Antibiotics. Penicillins, cephalosporins, and other β-lactams. Aminoglycoside antibiotics.
Antitumorals. Antimetabolites. Anthracyclines. Antibiotics.

Textbooks: educational material supplied by the teacher.

COMBINED COURSE: BIOINFORMATICS:

MODULE 1
(CORSO INTEGRATO: BIOINFORMATICA: MODULO 1)
Dr. Marco BARUCCA

Aims:
The course students will gain a broad interdisciplinary knowledge of bioinformatics, including the ability to use a wide range of basic bioinformatics software and software packages.

Previous Requirements:
General knowledge of gene structure and protein structure. Basic mathematical, chemical and physical concepts.

Topics:
Introduction to software for application in biology. Public biological sequence databases: history, catalog of current databases, organisation of database entries, entry identification and retrieval, storage and updating, evolution to adapt to new technologies. Analysis of single nucleic acid sequences: from restriction map to

gene structure prediction. Analysis of single protein sequences: from compositional analysis to 3-D structure prediction. Pairwise comparisons: dot plots and one-to-one alignment strategies, analysis of sequence similarities. Comparisons to databases: hardware and software strategies for generating and analysing very large numbers of pairwise alignments (BLAST). Multiple alignments: methods for detecting similarities within a family. Patterns, profiles and their extensions: generating an accurate description of a sequence motif and testing for its presence in a test sequence. Putting it all together: getting the most out of molecular sequence data.

Textbooks:
• G. Valle et al., **introduzione alla Bioinformatica**, Zanichelli, Bologna,
• D.W. Mount, **Bioinformatics: sequence and genome analysis**, Cold Spring Harbor Lab. Press.
• A.M. Lesk, **introduzione alla Bioinformatica,** McGraw-Hill Companies
• C. Gibas, and P. Jambeck, **Developing bioinformatics computer skills**, O´Reilly, Cambridge

COMBINED COURSE: BIOINFORMATICS
MODULE 2
(CORSO INTEGRATO: BIOINFORMATICA: MODULO 2)
Prof. Paolo MARIANI

Aims:
The course of Bioinformatics exemplifies the way traditional scientific and engineering disciplines are being transformed to face the challenges arising from the revolutionary developments in the life sciences. The course is in particular concerned with the analysis of biological information; providing tools and techniques for the interpretation of data. Current programs and the principles that underlie them will be discussed. The course is divided in 2 modules, the first being related to the sequence analysis and the second concerning the protein structure prediction problem. In both cases, the more commonly used softwares available on the Web will be discussed and analysed.
The course students will gain a broad interdisciplinary knowledge of bioinformatics, including the ability to use a wide range of basic bioinformatics software and software packages available on the Web.

Previous Requirements:
General knowledge of gene structure and protein structure. Basic mathematical, chemical and physical concepts.

Topics:
Introduction to software for application in biology. Public biological sequence databases: history, catalog of current databases, organisation of database entries, entry identification and retrieval, storage and updating, evolution to adapt to new technologies. Analysis of single nucleic acid sequences: from restriction map to gene structure prediction. Analysis of single protein sequences: from compositional analysis to 3-D structure prediction. Pairwise comparisons: dot plots and one-to-one alignment strategies, analysis of sequence similarities. Comparisons to databases: hardware and software strategies for generating and analysing very large numbers of pairwise alignments (BLAST). Multiple alignments: methods for detecting similarities within a family. Patterns, profiles and their extensions: generating an accurate description of a sequence motif and testing for its presence in a test sequence. Putting it all together: getting the most out of molecular sequence data.
The practical work will be performed at the Informatics Laboratory of the Faculty.

Textbooks:
- D.W. Mount, Bioinformatics: sequence and genome analysis, Cold Spring Harbor Lab. Press.
- G. Valle et al., Introduzione alla Bioinformatica, Zanichelli
- C. Gibas, and P. Jambeck, Developing bioinformatics computer skills, O'Reilly, Cambridge
- G. Zweiger, Transducing the genome: information, anarchy and revolution in the biomedical sciences, McGraw-Hill

MOLECULAR PHISIOLOGY
(FISIOLOGIA MOLECOLARE)

Dr. Rosamaria FIORINI

Aims: Students will analyze and study the molecular mechanisms of cell and tissue functions in animal organisms

Previous Requirements: General Physiology

Topics:
Cells and Genomes
Proteins, genes and evolution (Hb, motor proteins, ion channels, receptors)
Structure and functions of biological membranes
Electric membrane properties and synaptic transmission
Mechanisms of sensory transduction (vision)
Learning and memory
Genes and behaviour
Hemostasis and coagulation
Hormones and signal transduction
Integration of metabolism

Textbooks: All reference materials will be distributed in the class

APPLIED GENETICS
GENETICA APPLICATA))
Prof. Davide BIZZARO

Aims:
At the end of the course student will know some recent and paradigmatic applications of the genetics research both in biotechnological and biomedical area. Particular attention will be focussed on the discussion of the open problems related to the future use and management problems of the genetic application.

Previous Requirements:
A good knowledge of Cytology, Genetics, Molecular biology, and Biochemistry is required.

Topics:

- New methodologies for the functional and structural study of the genome.
- Epigenetics. Imprinting and the monoallelic gene expression. The histone code. MicroRNA and other non coding RNA. Epimutations and heredity.
- Transgenesis and cloning in vertebrates: nuclear reprogramming of gametes, zygotes, stem or differentiated cells.
- Gene regulation and cell differentiation by DNA or chromatin rearrangement. The case for gene amplification or gene elimination.
- Biology and genetics of fertility in human and model organisms. Recent application of biotecnology in Biology and Medicine of Reproduction.
- The genetics of pesticide resistance in insects: new methods of study and biotechnological control of parasite and disease vectors in human, animals and plants.

Textbooks:
Discussion of articles from scientific research:
Nature; Nature Genetics; Nature Reviews Genetics; Nature Reviews Molecular Cell biology; Nature Medicine; Nature Biotecnology; Science; Cell; Trends in Genetics; Trends in Cell Biology; Trends in Biotecnology; Annual Review of Genetics; Current Biology; Current Opinion in Genetics and Development; Genome Biology; Genome Research; BioTechniques; Bioinformatics, Biology of reproduction,Human reproduction, PLOS,…….

J D Watson, *BIOLOGIA MOLECOLARE DEL GENE*, Zanichelli
LH Hartwell et al,. *GENETICA: dall'analisi formale alla genomic*a Mc Graw-Hill
GIBSON, MUSE, *INTRODUZIONE ALLA GENOMICA* Zanichelli

MOLECULAR GENETICS
(GENETICA MOLECOLARE)
Dott. Marco BARUCCA

Aims:
This course will provides an overview of structure, function, evolution of the eukaryotic genomes and genes. Moreover, after the course knowledge and information regarding identification of human disease genes and the cancer genetics will be learnt by the students.

Previous Requirements:
Knowledge of basal concepts of genetic and molecular biology

Topics:
- The ground-breaking importance of genome projects; background and organization of the Human Genome Projects and genome projects for model organisms; Functional Genomics.
- Eukaryotic genomes: nuclear and mitochondrial. ***Organization*****,** ***distribution and function*** of polypeptide-encoding ***genes***, tandemly repeated noncoding DNA, interspersed repetitive noncoding DNA, transposable elements and retrotransposons.
- Evolution of gene structure and duplicated genes; evolution of chromosomes and genomes; comparative genomics; evolution of human populations.
- Identifying Human Disease Genes: principles and strategies.
- Cancer Genetics.
- Molecular Genetic of vertebrate immunoproteins.
- Strategies and method in Molecular Genetic.

Textbooks:
Tom Strachan e Andrew P. Read, "Genetica umana molecolare" UTET

GENETIC ENGINEERING
(INGEGNERIA GENETICA)
Dr. Tiziana CACCIAMANI

Aims: After the course the student should: (a) have acquaired the theorical and pratical skills necessary to constract and use recombinant DNA molecules and vectors, for the isolation characterization and expression of genes; (b) know the most common vectors used for cloning and producing recombinant proteins; (c) decide, according to different use/source of recombinant proteins, which biological system is optimal for expression; (d) evaluate the advantges and risks in the use of genetic engineering in different biotechnological fields.

Previous Requirements: Basic knowledge of DNA structure and functions, protein sctructures and functions, and good knowledge on prokaryotic and eukaryotic cells.

Topics: The course is organized in lectures and laboratory practice and its aim is giving to students basic knowledge for constraction and use of cloning and expression vectors containing recombinant DNA in prokaryotic and eukaryotic system.
- Prokaryotic systems- Short introduction on bacteria and phages biology; restriction enzymes and other enzymes usefull for DNA and RNA manipulations; chemical synthesis, sequencing and amplification of DNA; site directed mutagenesis; search gene in gene banks and computer analysis of data. Cloning and expression vectors based on plasmid and bacteriophage; transfection and selection methods; constraction of genomic and cDNA libraries; large scale production of recombinant proteins. **–Eukaryotic systems-** Short introduction on ekaryotic hosts, expression vector; transfection and selection methods utilized in yeast, insect cells and mammalian cells; production of recombinant protein in eukaryotes; vectors for gene, RNAi and Oligo therapies.
The laboratory practice will be organized as short research program.

Textbooks:
S. Primrose, R. Twyman, B.Old – Ingegneria Genetica, principi e tecniche- Zanichelli, 2004.
B.R. Glick, J.J. Pasternak – Biotecnologia Molecolare, principi e applicazioni del DNA ricombinante- Zanichelli, 1999.

RESEARCH AND DEVELOPMENT OF BIOACTIVE COMPOUNDS
(LABORATORIO R & D DI COMPOSTI BIOATTIVI)
Dr. Giovanna MOBBILI

Aims: The aim of this course is to analyse the issues concerning the synthesis of bioactive molecules focusing on the strategy adopted in complex organic molecules synthesis. The course work will also touch general basic themes and specific examples examined during laboratory practicals.

Previous Requirements: Fundamentals General Chemistry (CHIMICA I), Organic Chemistry (CHIMICA II) and of the main instrumental and laboratory techniques applied to organic synthesis (LABORATORIO DI BIOORGANICA, METODI DI DETERMINAZIONE STRUTTURALE). General knowledge on the chemistry of drug-receptor interactions may be useful (CHIMICA DEI RECETTORI)

Topics: 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. **Target identification methods. Rational approach to drug design:** organic synthesis methods analysis in chemo, regio, diastereo and enantioselectivity aspects. Principles of chiral auxiliary and catalyst utilization in asymmetric synthesis. Protector groups chemistry. Retrosynthetic approach in planning organic synthesis. Analysis of complex bioactive molecules total synthesis. **Combinatorial chemistry**: principles of organic molecules libraries construction. **Lead modification**: isosterism and conformational analogues.

Textbooks:
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.
Stuart Warren, **Organic Synthesis: The Disconnection Approach**, Wiley, 1983.
Stuart Warren, **Organic Synthesis: The Disconnection Approach, Workbook**, Wiley, 1983.

STRUCTURAL DETERMINATION METHODS
(METODI DI DETERMINAZIONE STRUTTURALE)
Dr. Elisabetta GIORGINI

Aims:
At the end of the course, the student will be able to analyze IR, NMR and Mass spectra of organic and biological compounds.

Previous Requirements:
Basic knowledge of principal classes of organic and biological compounds

Topics:
The electromagnetic radiation. UV-Visible Spectroscopy. Infrared Spectroscopy. Identification of Ir spectra of organic compounds. Biological applications of Microimaging FT-IR technique. 1H and 13C Nuclear Magnetic Resonance. Bidimensional methods. Analysis of 1H NMR spectra of organic compounds. Mass Spectrometry. principal frammentation. Analysis of mass spectra.

Textbooks:
Chiappe D'andrea – TECNICHE SPETTROSCOPICHE E IDENTIFICAZIONE DI COMPOSTI ORGANICI – Edizioni ETS
Hesse Meier Zeeh – METODI SPETTROSCOPICI NELLA CHIMICA ORGANICA – EdiSES

APPLIED MICROBIOLOGY
(MICROBIOLOGIA APPLICATA)
Dott. Francesca COMITINI

Aims: INVOLVMENT OF MICROORGANISM IN THE FOOD SCIENCE

Previous Requirements: GENERAL MICROBIOLOGY AND BIOCHEMISTRY

Topics:
INTRODUCTION TO MICROBIAL FOOD SCIENCE
ROLE OF MICROORGANISMS
FOOD CONTAMINATION
ENOLOGICAL MICROBIOLOGY, INTRODUCTION
GRAPE MUST AND WINEMAKING
WINE MICROORGANISMS
GENETIC ANALISYS OF SACCHAROMYCES CEREVISIAE
NATURAL FERMENTATION
MALOLACTIC BACTERIA
MALOLACTIC FERMENTATION
ACETIC BACTERIA AND THEIR ROLE IN WINE
MILK PRODUCTS, INTRODUCTION
LACTIC ACID BACTERIA
MICROORGANISMS IN THE MILK AND CHEESES
FERMENTED MEAT PRODUCTS
HACCP SYSTEM, INTRODUCTION AND GENERALITY

Textbooks:
GALLI VOLONTERIO AM, MICROBIOLOGIA DEGLI ALIMENTI, CASA ED. CEA

BIOMOLECULAR MODELING AND DESIGN (MODELLISTICA E DESIGN BIOMOLECOLARE)

Dr. Roberta GALEAZZI

Aims:
The main course objectives are the description of the computational methods used for the simulation of biological chemical systems. At the end of the course the student must know the principle tecniques useful for the energy, molecular geometry and conformational analysis of small and big molecules. Furthermore the student must be able to applicate these methods to solve some basic biological and chemical problems.

Previous Requirements:
Topics:
Introduce the student into basic molecular modeling and focalize its possibile application to solve relavant chemical biological problems.Give the students a complete view of the computational strategies used for the simulations of biological systems at molecular level. In the last decade molecular modeling improved thanks both to the increased power of calculation and to the development of new potent simulation alghorithm. Thus, these computational tecniques are now able to study more complex problems such as the development of anew drug or the molecular recognition.

Textbooks:
J.M.Goodman, *Chemical applications of molecular modelling* (Royal Society of Chemistry, 1998) Szabo e N.S. Ostlund, *Modern Quantum Chemistry - Introduction to advanced electronic structure Theory,* Dover Publications, 1996.
A.R. Leach, *Molecular Modeling - Principles and applications,* Longman, 1996.
Alan Hinchliffe, *Modelling molecular structures*, Wiley, (1996).
G.H.Grant, W.G.Richards, *Computational Chemistry*, Oxford Science publications, Oxford university Press, 1995.
C.J.Cramer, *Essentials of Computational Chemistry: Theories and Models,* John Wiley & Sons, 2002.

BIOMOLECULAR NANOTECHNOLOGIES (NANOTECNOLOGIE BIOMOLECOLARI)

Dr. Gianluca MARTELLI

Aims
Knowledge of basic concepts and strategic “bottom-up” fabbrication of nanostrucures. Definition of nanotechnology and nanoscale.

Applications of Dna and protein nanostructures in biology and medicine. Importance of nanomaterials and nanodevices in diagnostic, drug delivery and nanomedicine.

Previous Requirements.
Basic knowledge of organic chemistry and biochemistry.

Topics.
1) Nanotechnology and nanostructures.
Definition of a nanostructure. The nanoscale. Nanostructures in nature: sponges. Self-assembly. Amphiphilic structures. Non-covalent interactions and □-stacking.

2) Nanotubes and fullerenes.
Chemistry of carbon. Fullerene: synthesis e proprieties. Biological applications. Graphene. SWNT e MWNT. Functionalization of nanotubes: direct functionalization and for □-stacking. Nanotubes and nucleic acid. Medical and biological applications.

3) Peptides and nanostructures.
Carboxilic acid and amines: basic. Peptides and secondary stuctures. The folding problem. Tertiary Structure. □- and □-aminoacids. □-Aminoacid in the peptide's structures. Definition and proprieties of foldamers. The phi and psi angles and secondary structures. Biological applications. From structures to biological functions. Other foldamers: classification.
Molecular recognition. Protein-protein interaction: EPO, calixarene derivaties. □- and □- foldamers. Peptoids.

4) Dna nanotechnology.
Dna proprieties and stability. Use of Dna at the nanoscale (base pairing). DNA as amphiphilic system and nanomaterial. Dna self-assembly. Nanofabrication with Dna. Cube. Troncated Octahedron. 1-D and 2-D rigid array. Biological and medical applications: nanowires, Au nanoparticles, nanoshells, nanotubes. Dna as template. Dna machines and nanodevices. DNA microarrays. Application in nanomedicine (diagnostic).

5) Applications.
Nanostructures and biological systems. Biomaterials. Catenanes and rotaxanes. Molecular machines. ATP-sintase. Kinesine. Nanomedicine, nanopharmacology and nano-oncology. Nanosensors: definition and applications. Dna computing. Dna in organic chemistry.

Textbooks.
D.S. Goodsell; *Bionanotechnology:Lessons from nature*. Wiley, New York, **2004**
Slides and documents from lessons.

RECEPTORS STRUCTURE AND CHEMISTRY (STRUTTURA E CHIMICA DEI RECETTORI)

Dr. Roberta GALEAZZI

Aims:
At the end of the teaching, the student must know the terminology and the principal receptorial theory developed during the last decades. The focus should be put on various kind of receptors and particularly on the neurotransmitters receptors. Furthermore; the student must be able to find the path to develop a receptorial drug; starting from a lead compound and ending with the molecular interaction with its own receptor: this can be achieved by using also computational tecniques.

Previous Requirements:

Topics:
Basic receptor concepts: structures of main receptor classes and their properties.Drug-receptor interactions and biologial response. Receptor theories. Agonism and anthagonism. Neurotransmitters' and oppioid receptors . Methods for studing ligand-receptor interactions. Lead identification and optimization. Lead modification strategies. Molecular modeling of ligand-receptor complex. Receptor surface models.

Textbooks:
C. Melchiorre, *I Recettori dei Neurotrasmettitori*, CLUEB, Bologna, 1996.
G. Ronsisvalle, M.Pappalardo, L. Pasquinucci, O.Prezzavento, *I Recettori Oppioidi*, CLUEB, Bologna, 1999.
F. Gualtieri, M.N. Romanelli, E.Teodori, *Chimica Farmaceutica dei recettori*, CLUEB, Bologna

ENZYMATIC TECHNIQUES AND SYNTHESES
(TECNICHE E SINTESI ENZIMATICHE)
Dr. Giovanna MOBBILI

Aims: The aim of this course is to introduce transformation techniques of non natural compounds by means of enzymatic catalysis and to apply this to some laboratory practicals.

Previous Requirements: Fundamentals of General Chemistry (CHIMICA I), Organic Chemistry (CHIMICA II), Biochemistry (CHIMICA BIOLOGICA).

Topics: Brief introduction on biotransformations. Enzymatic transformation methods applied to organic synthesis. Esters and phospholipids preparation by lipases. Acylases in antibiotics and beta-lactams synthesis. Dehydrogenases in alcholic groups oxidations. Oxygenases used in aliphatic chains and steroids hydroxylation. Aldolases in C-C bonds formation. Biocatalysis applications: examples of bioactive compounds preparation. Chemo-enzymatic synthesis. Enzyme reactivity in non aqueous environments: application to organic synthesis.

Textbooks:
K. Faber, **Biotransformation in Organic Chemistry 3rd Edition**, Springer, 1997.
Carl Branden, John Tooze, **Introduzione alla struttura delle proteine**, ZANICHELLI, Bologna, 2001
Alan Fersht, **Struttura e meccanismi d' azione degli enzimi**, ZANICHELLI, Bologna, 1989.

MEDICAL AND MOLECULAR VIROLOGY
(VIROLOGIA BIOMEDICA)
Prof. Patrizia BAGNARELLI

Aims:
The course is organized in a number of lectures arranged into two parts. The part one deals with general virology (virus definition, morphology, classification, replication strategies, viral genetics, viral vaccines and chemotherapy); the part two deals with the specific virus families focusing on their distinctive characteristics
The principal aim of the course is to provide students with a thoroughly and complete knowledge on the viral agents involved in a number of human infectious diseases. This knowledge could be useful for a future employement in a Microbiology lab at a Hospital or University setting.

Previous Requirements:
Basic principles of cell biology and innate/adoptive mechanisms of the immune defence

Topics:
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, Flaviviruses, Rhabdoviruses, Arenaviruses, Hantaviruses, Filoviruses, Picornaviruses, Reoviruses, Coronaviruses, Retroviruses and HIV); Hepatitis Viruses.
Textbooks:
Jawetz, Melnick, and Adelberg's “Medical Microbiology” Last edition.
Patrick Murray Ken Rosenthal G. Kobayashi M. Pfaller: “Medical Microbiology” (Last Edition)

POSTGRADUATE PROGRAM
MARINE BIOLOGY
ACADEMIC YEAR 2009/2010
CLASS LM-6
COURSE CONTENTS

AQUACULTURE AND ACQUARIUMS
(ACQUACOLTURA E ACQUARIOLOGIA)

Dr. Ike OLIVOTTO

Aims:
mesocosms menagement and set-up, recognizing and maintaining marine species, culturing phyto and zooplankton, reproduction in captivity

Topics:

- Introduction
- Coral reef ecosystem: distribution and characteristics.
- The aquarium: tanks, lightening, heaters, chillers.
- Filtration systems and water chemistry: the nitrogen cycle, different filtration systems, pH, temperature and salinity.
- Sand, gravel, rocks and invertebrates.
- Marine aquarium fishes: pomacentrids, apogonids, serranids, butterfly fish, pomacantids, wrasses, gobies, surgeon fish , balistids, zanclids, dottybacks. Distribution, characteristics.
- The life cycle of reef fishes: reproductive strategies.
- Fishing and transport methods: the market of the aquarium trade.
- Reproduction in captivity: photoperiod and temperature.
- Food web: phyto and zooplankton. Culturing methods.
- HUFAs in marine fish diet.
- Examples of captive bred organisms: pomacentrids, gobies, pomacantids, dottybacks, seahorses.
- Intensive and estensive aquaculture
- Floating in-shore cages
- off-shore cages and tension- legs
- Introduction to some of the most common diseases
- Farming marine species (Sea Bream, Sea Bass, Salmon): reproduction, farming techniques, larval feeding, growth out.
- Farming fresh water species (trout, surgeon): reproduction; farming techniques, larval feeding, growth out.
- Farming crustaceans and mollusks.

- **Textbooks:**
- SAROGLIA M., INGLE E. "Tecniche di Acquacoltura"; Edagricole
- BARNABE' G. "Acquaculture" Vol. I, II, Technique et Documentation Lavoisier
- ROBERTS R.J. Patologia dei pesci" Edagricole Bologna
- Wilkerson, J.D., 1998. Clownfishes. A Guide to Their Captive Care, Breeding and Natural History, 1st Ed. Microcosm Ltd. Shelburne.
- Thresher, R. E., 1884. Reproduction in reef fishes. T F H Publications, Inc Ltd.

MARINE SEDIMENTARY ENVIRONMENT ANALYSIS
(ANALISI DELL'AMBIENTE SEDIMENTARIO MARINO)

Dott. Alessandra NEGRI

Aims: the study of modern sediments such as sand mud (silt) and clay,and the processes that result in their deposition through time.

Previous Requirements: marine geology

Topics:.
Introduction to sedimentology; sedimentary cycles, weathering processes; sediment production.
Classification of siliciclastic rocks; sediment maturity; introduction to fluid mechanics;grain transport and deposition. Clastic depositional systems; sedimentary structures. Tectonic regimes and terrigenous clastic sediments; facies concepts. chps. Marine and deltaic depositional systems; bioturbation. Introduction to biochemical and chemical sediments: carbonate rocks and evaporites.
Classification of carbonate rocks and depositional environments.
Oceanographic controls on sedimentation. Shallow marine environments Shelf and tidal flat depositional environments.
Sedimentary rock diagenesis: porosity, permeability, and hydrologic characteristics
The nature of sedimentation through time: unconformities and other stratigraphic
Surfaces.

Textbooks:
1)Franco Ricci Lucchi Sedimentologia, Pitagora editore
2)Franco Ricci Lucchi, Sedimentografia, Zanichelli

MARINE ANIMAL BIODIVERSITY
(BIODIVERSITA' DEGLI ANIMALI MARINI)
Dr. Barbara CALCINAI

The value of Biodiversity; The importance of the taxonomy; Factors increasing biodiversity: Speciation in the sea. The origin of Mediterranean fauna;
Biogeography; Coral reef biodiversity; Biodiversity and spatial complexity.
Biodiversity in special Mediterranean habitats (e.g. Coralligenous, *Cladocora caespitosa* banks, *Sabellaria* banks) Marine caves, Conero promontory. Factors for the decrease of biodiversity:

During the course the taxonomy of some marine groups will be studied by laboratory exercises

Aims:
To achieve general knowledge on marine biodiversity, focusing on the biodiversity in the Mediterranean Sea. During the course practical sessions will give to the students tools for the taxonomic identification of the principal marine groups.

Previous Requirements:

Topics:

Textbooks:
Didactic material from the teacher.
Suggested books:
Biodiversity an Introduction. Gaston & Spider. Blackwell Science.
Biogeografia. La dimensione spaziale dell'evoluzione. Zumino & Zullini. Casa Ed Ambrosiana.
Understanding Marine Biodiversity. national research consil. national academy press.
Current publications available on the web.

MARINE PLANT BIODIVERSITY
(BIODIVERSITÀ DEI VEGETALI MARINI)
Dr. Cecilia Maria TOTTI

Aims:
Aim of this course is to provide students the instruments for understanding the aspects of biodiversity of marine plants. The systematics and ecology of algae groups and marine Angiosperms will be treated. The knowledge on biodiversity of plant communities in the marine environments will be investigated, tackling the problem of influence of human impact on biodiversity changes and considering the influence of climatic fluctuations. Students will be provided with the instruments and the methodological approaches to study marine plant groups.

Topics:

Introduction to biodiversity. Human factors affecting biodiversity. Alien species in plant communities of the Mediterranean Sea.
Systematics and ecology of Cyanobacteria (Cyanophyta, Prochlorophyta), Euglenophyta, Chlorarachniophyta, Glaucophyta, Cryptophyta, Haptophyta, Alveolata (Dinophyta), Stramenopiles (Chrysophyceae, Bacillariohyceae, Dictyochophyceae, Raphidophyceae, Phaeophyceae), Rhodophyta, Chlorophyta (Prasinophyceae, Ulvophyceae, Chlorophyceae, Charophyceae).
Phytoplankton communities: biogeography and diversity of phytoplankton in the Mediterranean Sea. Study cases: changes in phytoplankton communities in relation to climate.
Biodiversity of microphytobenthos communities: epipelon, epipsammon, epilithon, epiphyton, epizoon; growth forms of benthic microalgae; importance and ecological role of microphytobenthos. Methods applied to the study of microphytobenthic communities.
Seaweed communities: litophytic, psammophytic, epiphytic and drift seaweeds; the macroalgae of the Mediterranean Sea. Algae morphotypes: relationships with grazing and production.
Seagrass biodiversity and biogeography; the seagrasses of the Mediterranean Sea; meadow types. Ecological importance of seagrasses. Factors affecting the seagrass regression. Systematics of the Mediterranean seagrasses.
Factors affecting the growth of benthic macrophytes. Vegetation plans and plant communities.
Harmful algal blooms. Toxic microalgae and biointoxications (DSP, PSP, NSP, ASP, CFP, AZA). Raphidophyte and Haptophyte toxins.
The mucilage phenomenon; hypothesis and significance of production and persistence of macroaggregates. Factors affecting genesis and evolution of phenomenon.
Marine plants of coral reefs. Phytoplankton cycle and toxic species in tropical areas. Endosymbiosis between microalgae and marine invertebrates; zooxanthellae: biological and morphological characteristics of zooxanthellae; factors affecting bleaching. Tropical seaweeds: growth forms; role of calcareous algae in the ecology of coral reefs. Mangroves: biogeography; morphological, physiological and reproductive adaptations; biogeography; ecological role; natural and human impact on mangrove communities.

Textbooks:
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.

REPRODUCTIVE BIOLOGY
(BIOLOGIA DELLA RIPRODUZIONE)
Prof. Oliana CARNEVALI

Aims: This course provides the students fundamental tools to understand the molecular mechanisms involved in the reproduction and the methodologies to study the life cycle of marine species for the evaluation of natural fish stocks. The student will be able to evaluate the presence and the potentiality of some pollutants to interfere with the reproductive functions of teleosts.
The students will be able to apply the basic knowledge provided by the course in the aquaculture practice as a supplement to natural stock

Topics:
Introduction to biology reproduction course
Endocrine control of reproduction : hypothalamus- pituitary-gonadal axes.
Pineal glad and reproduction
Sexual determination and puberty in fish.
Germinal cells cycle.
Vitellogenesis : hormonal control of vitellogenin synthesis ,egg types and reproductive strategies
Biotechnology of reproduction
Reproductive toxicology.
Stress and reproduction : hypothalamus-pituitary- interregnal axes
Application of biotechnology and molecular tools in aquaculture to improve animal welfare

Textbooks:
Norris DO Vertebrate Endocrinology. Third edition Academic Press
P.Baben, J Cerdà and E.Lubzens Edts. The fish Oocyte: from basic studies to biotechnological applications. Spring

BIOLOGY OF THE ALGAE
(BIOLOGIA DELLE ALGHE)
Prof. Mario GIORDANO

Aims:
The student will acquire the notions necessary to distinguish the main functional algal groups and will be introduced to the mechanisms through which algae interact with the environment. In addition to this the student will acquire the ability to independently and creatively analyze primary sources of information and to use them in a scientific/reserach context.

Previous Requirements:
-Literature search skills
-Sufficient knowledge of the English language to allow comprehension of the scientific literature
-Thorough knowledge of chemistry, biochemistry and physical-chemistry, and plant/algae cytology
-Basic knowledge of algae and plant structure and of their phylogenetic relationships

Topics:
Competition for resources:
Nutrients (N, S, P and trace nutrients): uptake, assimilation and metabolic interactions
Light: chromatic adaptation, macroalgal zonation
Substrate: survival in the intertidal zone
Phytoplankton and Global Climate Change:
Physiological responses to CO2, temperature and UV variations
Morphology and Function:
Size and shape: effects on the physiology of phytoplankton, allometry
Applicative aspects:
Algal cultures; commercial products from macroalgae and microalgae
Phytoplankton evolution:
Endosymbiotic theory; interactions between the environment and the evolution of phytoplankton

Textbooks:
Buchanan, Gruissem and Jones (2004). Biochimica e Biologia molecolare delle Piante. Zanichelli
Falkowski e Raven (1997). Aquatic Photosynthesis. Blackwell
Lobban and Harrison (1996). Seaweed Ecology and Physiology. Cambridge University Press
Dring (1982) Biology of Marine Plants. E. Arnold
Knoll (2004). Life on a Young Planet: the First Three Billion Years of Evolution on Earth. Princeton University Press

EVOLUTIONARY BIOLOGY OF MARINE VERTEBRATES
(BIOLOGIA EVOLUTIVA DEI VERTEBRATI MARINI)
Prof. Vincenzo CAPUTO

Aims: At the end of the formative way the student will have to know the main experimental and analytical methods to evaluate how some biological processes like mutation, selection, migration and drift produce evolutionary change. Furthermore the student will have to master some software packages for the phylogenetic reconstruction.

Previous Requirements: A basic knowledge of genetics, zoology and ecology is required.

Topics:
1) The coming of the modern evolutionary thought. Darwin and the natural selection; the neodarwinism and the “new synthesis”; phyletic gradualism vs punctuated equilibria; the neutral theory of molecular evolution.
2) Classification and evolution. Definitions and examples of taxonomic characters (morphological vs molecular; general vs special adaptations); taxonomic schools (numerical taxonomy, cladistics and evolutionary taxonomy); softwares for phylogenetic reconstruction (PAUP, PHYLIP).
3) Microevolution. The Hardy-Weinberg principle; gene flow and drift; species concepts; geographic variation and speciation; speciation in marine environment; stock concepts and fishery management; bases of biogeography.
4) Macroevolution. Omeotic genes and body plan organisation; the origin of the high order taxa; evolutionary trends and mass extinction. Bony fishes as an example of primary radiation in aquatic environment: origin

and evolution; biological and ecological traits of marine species. Marine reptiles (turtles) and Mammals (sirenians, pinnipeds and cetaceans) as examples of ricolonisation of aquatic environment from terrestrial ancestors: origin and evolution; biological and ecological traits of extant species and conservation problems.

Textbooks:
Balletto E., 1995. Zoologia evolutiva. Zanichelli.
Berta A., Sumich J. L., 2001. Marine mammals. Evolutionary biology. Academic Press.
Freeman S., Herron J. C., 2004. Evolutionary analysis. Third edition. Prentice Hall.
Ridley M., 2004. Evolution. Third edition. Blackwell Scientific Publications.

MARINE ECOSYSTEMS CONSERVATION AND MANAGEMENT
CONSERVATION AND MANAGEMENT OF NATURE AND ITS RESOURCES
(CONSERVAZIONE DELLA NATURA E DELLE SUE RISORSE)
(CONSERVAZIONE E GESTIONE DEGLI ECOSISTEMI MARINI)
Dr. Antonio PUSCEDDU

Aims:
The course aims at providing the students with the ecological principles and the national and international guidelines of the conservation and management of marine ecosystems, with a particular focus on the methods and criteria for siting, sizing and the sustainable management of marine protected areas

Topics:
Introduction to the basic principles of conservation and management of marine ecosystems. Ecological integrity and vulnerability of marine coastal environments; ; extinctions, invasions and species substitutions; guidelines for the conservation of marine ecosystems: habitat and species conservation; threatened, rare and endemic species; definition of a marine protected area (MPA): siting and management criteria; MPA typologies; Italian national legislation for MPAs; selection and siting of MPAs: social, economical and ecological criteria; zonation of MPAs; creation and adaptive management of MPAs; control and monitoring MPAs: prohibitions, limitations, surveillance. Reserve effects: buffer, refuge and trophic cascades. The cultural significance of MPAs.

Textbooks:
- DELLA CROCE, CATTANEO VIETTI, DANOVARO, Ecologia e Protezione dell'ambiente marino costiero, UTET, 1998.
- S. GUBBAY, Marine Protected Areas: Principles and Techniques for Management, Chapman & Hall , NY, 1995.
- R.B. PRIMACK, L. CAROTENUTO, CONSERVAZIONE DELLA NATURA , Zanichelli, Bologna, 2003.

ECOPHYSIOLOGY OF ALGAE
(ECOFISIOLOGIA DELLE ALGHE)
Prof. Mario GIORDANO

Aims:
The student will acquire the notions necessary to distinguish the main functional algal groups and will be introduced to the mechanisms through which algae interact with the environment. In addition to this the student will acquire the ability to independently and creatively analyze primary sources of information and to use them in a scientific/reserach context.

Previous Requirements:
-Literature search skills
-Sufficient knowledge of the English language to allow comprehension of the scientific literature
-Thorough knowledge of chemistry, biochemistry and physical-chemistry, and plant/algae cytology
-Basic knowledge of algae and plant structure and of their phylogenetic relationships

Topics:
Competition for resources:
C: the inorganic cC system in solution; CO2 acquisition (CO2 concentrating mechanisms) and interplay of C with the other nutrients
N, S, P and trace nutrients: uptake, assimilation and metabolic interactions

Light: physics of light in the ocean; light capture, conversion of electromagnetic energy to chemical energy, vertical zonation
Substrate: survival in the intertidal zone
Allelopathy: exclusion and defence mechanisms in algae
Phytoplankton and Global Climate Change:
Physiological responses to elevated CO2, temperature and UV
Morphology and Function:
Size and shape: effects on the physiology of phytoplankton, allometry
Applicative aspects:
Algal cultures; biotechnological uses of algae
Phytoplankton evolution:
Endosymbiotic theory; interactions between the environment and the evolution of phytoplankton

Textbooks:
Buchanan, Gruissem and Jones (2004). Biochimica e Biologia molecolare delle Piante. Zanichelli
Falkowski e Raven (1997). Aquatic Photosynthesis. Blackwell
Lobban and Harrison (1996). Seaweed Ecology and Physiology. Cambridge University Press
Dring (1982) Biology of Marine Plants. E. Arnold
Knoll (2004). Life on a Young Planet: the First Three Billion Years of Evolution on Earth. Princeton University Press

MARINE ECOLOGY
(ECOLOGIA MARINA)
Prof. Roberto DANOVARO

Aims:
To the end of the instruction the student will have to know the functioning of all types of marine ecosystems and to resolve the different types of environmental problems for the biodiversity conservation. The student will develop specific knowledge relative to the sampling, surveying and deepening of the various aspects of marine Biology.

Previous Requirements:
Marine Biology

Topics:
Characteristics of marine ecosystems, Sampling methodologies and instruments for research in marine biology. Biodiversity in marine environment, Study of the ecology of lagoons and confined ambient; ecology of estuaries, deep seas, coral reefs, Mediterranean reefs, marine caves, hydrothermal vents and cold seeps, marine seagrass ecosystems and mangrove, artificial marine ecosystems and polar environments.Biological resources: intensive and extensive aquaculture. Protection of marine organisms and marine reserves. Marine pollution: biology and biological indicators. Management and control of the renewable resource.

Textbooks:
• Della Croce N., Cattaneo Vietti R., Danovaro R., Ecologia e protezione dell'ambiente marino costiero., UTET UNIVERSITA', 1998.
• Danovaro, Recupero ambientale: tecnologie, bioremediation, biotecnologie, UTET, 2001.
• Nybakken J.W., Marine Biology An Ecological Approach, Harper Collins, 1993

FUNDAMENTALS OF ENVIRONMENTAL IMPACT ASSESSMENT
(FONDAMENTI DI VALUTAZIONE DI IMPATTO AMBIENTALE)
Dr. Stefania GORBI

Aims:
The Course is aimed to prepare students for defining quality standards, the integrated complexity between development of productive activities and environmental protection, management options and environmental impact assessment, remediation and monitoring of polluted areas.
At the end of the course the student should have the capability to:
1. Describe fundamentals and general principles of environment impact assessment.
2. Apply conceptual criteria for defining quality criteria in different environmental matrices.

3. Apply criteria for environmental management of coastal areas, dredging, remediation and coastal erosion.

Previous Requirements:
A good knowledge of ecotoxicology and ecological processes are important requisites for this course.

Topics:
- Definition and design of an environmental impact assessment, main normative guidelines for VIA and VAS (environmental and strategic impact assessment).
- Economy and normative restrictions to prevent, limit, monitor and remediate environmental pollution.
- Environmental and biological resources, use and economical issues.
- Quality standard for the environment; formulation, technical aspects and critical points in setting limits for quality standards.
- Environmental management systems: EMAS CE 761/01 and UNI EN ISO 14001/04.
- Waste management: comparison between terrestrial and marine environment.
- Management of contaminated marine sediment: analytical procedures to characterized the quality.
- Practical examples on management options and technical approaches in dredging and disposal of sediments.
- Remediation of contaminated marine area

Textbooks:
Dispense e letteratura scientifica indicata sui singoli argomenti trattati.
ICRAM APAT Agosto 2006. Manuale per la movimentazione dei sedimenti marini.
"Valutazione di Impatto Ambientale", 2006. Editore Esselibri-Simone
Marchello, Perrini, Serafini, " Diritto dell'Ambiente" VII Edizione. Editore Esselibri-Simone

UNDERWATER SCIENTIFIC METHODOLOGY (METODOLOGIE SCIENTIFICHE SUBACQUEE)

Dr. Carlo CERRANO

Aims:
The course will show the main underwater techniques for the study of marine coastal environment. Diving physiology, diving equipment, sampling design, underwater survey techniques, and underwater sampling will be the main topics presented during the corse. The scope is to give basal knowledges both theoretical and practical on the study of marine environment by SCUBA diving.

Previous Requirements:
SCUBA licence (at least first level)

Topics:
Diving: effects on man
- Physiological effects
- Psychological effects

Diving equipment
- Mixed gas diving
- Protective systems
- Communication systems
- Transport systems
- Cave diving

Diving plan
- Dive tables and Computers

Destructive sampling techniques
- Scraping
- Panels
- Water dredges
- nets
- traps

Non destructive sampling techniques
- Frames and transects
- Video and photo surveys
- visual-census

Volunteers and monitoring project

Transplants techniques
Underwater microsensors

Field activities are scheduled to teach directly underwater some of the studied techniques. Students could get a diving licence during the course.

Textbooks:
Slides showed during lectures will be provided to the students

MARINE MICROBIOLOGY
(MICROBIOLOGIA MARINA)
Dr. Carla VIGNAROLI

Aims:
At the end of the course students will have to know metabolic and physiological features of the main taxonomic groups of marine microrganisms; they will also have to know the adaptative and survival strategies of procaryotic and protistan cells in the sea, the fundamental role of microbes in marine ecosystem and the interactions between particular microbial species and the environment or other marine organisms. Students will develop knowledge about pathogenicity mechanisms of some important human and/or fish pathogens and they will also learn to describe sampling, cultivation and identification methods to be used in marine microbial communities studies and in bacterial detection from sea-water samples

Previous Requirements:
knowledge of biochemistry, cytology, genetics and elements of microbiology

Topics:
Marine environment: general characters and microbial communities. Distribution of the microbial populations in the marine habitats. The microbial loop and microbial food web. Role of microrganisms in the cycles of the main elements (sulphur, nitrogen and carbon cycles).
Mechanisms of energy production among oligothrophic bacteria.
Taxonomy and methods to study microbial evolution.
The main marine taxonomic groups of eubacteria. Photosynthetic bacteria,
prochlorophytes and cyanobacteria, strategies and evolution of the most abundant photosynthetic bacteria in the oceans, microbial spheres and gliding motility in cyanobacteria. Toxic cyanobacteria and harmful algal blooms. Chemoheterotrophs bacteria among marine proteobacteria,bacteria of the genera *Pseudoalteromonas*, *Aeromonas* e *Vibrio*.
Bacteria in extreme environments: general characters of Archaea and their strategies of adaptation. The extreme thermophiles and halofiles, the methanogens. Hydrothermal vents community and black smokers. Marine virus and their role in the prokaryotic biodiversity.
Sampling methods and detection of microrganisms. Isolation and cultivation of marine microbes, culture media for marine populations, viable but non culturable cells.
Interaction of microrganisms with marine environment, the chemotaxis, bacterial movement in aqueous environmental, adhesion and colonization of surfaces, structure and formation of biofilms. Air-water interface, bacterioneuston and hydrocarbon-degrading marine bacteria, sediment-planktonic interface and microbial mats.
Interaction of microrganisms with other aquatic organisms, positive and negative relations.
The quorum sensing mechanism, the biochemistry and biology of bacterial and dinoflagellata bioluminescence.
Microbial water pathogens and epidemiology of main water related diseases Indicator organisms of water contamination and water quality.

Textbooks:
Brock, Madigan, Martino, Parker, "Brock biologia dei microrganismi", CEA Ambrosiana, terza edizione 2007, volume 1 e 2

Barbieri, Bestetti, Galli, Zannoni- Microbiologia ambientale ed elementi di ecologia microbica - Casa Editrice Ambrosiana, edizione 2008

ENVIRONMENTAL MODELLING
(MODELLISTICA AMBIENTALE)

Dr. Aniello RUSSO

Aims: To provide the basic techniques and methods of numerical modelling needed to apply simple hydrodynamic and ecosystem models.

Previous Requirements: none; it is advisable a good knowledge of oceanography, math, marine ecology and marine biology

Topics:
Physical and chemical properties of seawater. Maine dynamics. Air-sea interactions. The equations of motion in oceanography. Turbulence. Boundary and initial conditions. Eulerian and Lagrangian approaches. Advection and diffusion. Numerical methods. Data assimilation. Atmosphere-ocean coupled models. Basic models of the marine ecosystems. Concepts of Individual Based Models. N-P-Z e N-P-Z-D models. Coupling among oceanographic and biogeochemical flux models. Hydrodynamic and biogeochemical fluxes numeric simulations.

Textbooks:
- S.Pond, G.L. Pickard, **Introductory Dynamical Oceanography**, Pergamon.
- W.Fennel, T. Neumann, **Introduction to the Modelling of Marine Ecosystems**, Elsevier.

PHYSICAL OCEANOGRAPHY
(OCEANOGRAFIA FISICA)
Dott. Aniello RUSSO

Aims: By the end of the course, the student will must to know the basic mechanisms and processes of the physical oceanography which rule the circulation and the main physical properties of the sea, as well as to describe the main characteristics of the oceans, of the Mediterranean Sea, of the Adriatic Sea.

Previous Requirements: none, it is strongly advisable a good knowledge of math and physics

Topics:
Basic concepts:
Historical developments. Main marine characteristics. Main math operators and their physical meaning. Boundary conditions. Operatori.
Marine Dynamics:
The equations of motion. Friction and turbolence. Equations of motion with viscosity. Geostrophic computations. Response of the upper ocean to winds. Deep circulation. Numerical models. Periodic motions. Coastal processes.
Descriptive oceanography:
Intruments and methods of measurements. Main climatologic characteristichs of oceans and Mediterranean Sea. Variability at different spatial and time scales.

Textbooks:
R.H. Stewart, "**Introduction To Physical Oceanography**", Texas A & M University, pdf freely downloadable
S. Pond and G.L. Pickard, "**Introductory Dynamical Oceanography"**, Pergamon Press.
Open University Course Team, "**Ocean Circulation"**, Butterworth-Heinemann.
G.L. Pickard and W.J. Emery, "**Descriptive Physical Oceanography",** Butterworth-Heinemann.

APPLIED PALEOECOLOGY
(PALEOECOLOGIA APPLICATA)
Dr. Alessandra NEGRI

Aims: Practical use of the paleoecology methodologies aiming to reconstruct past environments. Knowledge of the paleoenvironmental changes

Previous Requirements: Marine Geology

Topics:

Paleoecology and Paleontology: definitions contents and purposes; Application and integration with life sciences. Ecology and paleoecology: role of paleoecology in life science. Facies concept. Uniformitarianism: meaning and limits. Fossilisation processes. Autochtonous and allochthonous fossils, reworking.

Textbooks:
• B.U. HAQ, A. BOERSMA, **Introduction to marine Micropaleontology**, 1980.
• Brenchley P.J. & Harper D.A.T, **PALEOECOLOGY**, Chapman & Hall, 1998.

TECHNOLOGY FOR MARINE ENVIRONMENT PROTECTION
(TECNOLOGIA PER LA TUTELA DELL'AMBIENTE MARINO)
Dr. Francesca BEOLCHINI

Aims: At the end of the course the student will know main technologies used for marine environment reclamation: oil spill response, wastewater treatment, contaminated sediments management.

Previous Requirements: none

Topics: *Oil spills*. Oil behaviour in the marine environment. Classification of main technologies aimed at oil spill treatment: physical, chemical, biological. Confining and recovery technologies: booms, skimmers, pumps. Dispersant and non dispersant chemical agents. In situ combustion technologies. Bioremediation. *Industrial and municipal wastewater*. Activated sludge processes with suspended and fixed biomass. Nutrient removal technologies: nitrification, denitrification, phosphorous removal. Membrane technologies (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Membrane bioreactor systems (MBR). *Management of contaminated sediments*. Dredging technologies. In situ/ex situ technologies.

Textbooks:
Fingas, M.F., Charles, J.," The basics of oil spill cleanup", CRC Press, 2000;
Metcalf & Eddy " Wastewater Engineering - Treatment, Disposal, Reuse" Mc Graw Hill, 1991.

POSTGRADUATE PROGRAM
ENVIRONMENTAL SUSTAINABILITY AND CIVIL PROTECTION
CLASS LM-75
ACADEMIC YEAR 2009/2010
COURSE CONTENTS

COMBINED COURSE: EMERGENCY INTEGRATE MANAGEMENT
Module 1: Emergency planning
(Corso integrato: Gestione integrate dell'emergenza – Modulo 1: Pianificazione delle emergenze)
Dr. Fausto MARINCIONI

Aims:
Emergency planning is a vital tool of civil protection (emergency management). Preparing an emergency management plan requires thorough analysis of the risks present in the territory, elaborate maps of such risks and develop possible scenarios. Also important is the definition and location of the resources (public or private) accessible in the area (information necessary to define the model of intervention and establish actions and strategies). Developing and updating emergency management plans, besides increasing the effectiveness of search and rescue activities, also help mitigate risks and provides guidelines for a rational reconstruction after the disaster. Effective emergency planning requires different tools and involves different actors with a variety of roles, authority and jurisdictions (from the Mayor of a city to a computer technician, from a communication specialist to an administrative secretary office). The purpose of this course is to introduce the students to the principles of emergency planning emphasizing that the effectiveness of emergency management rests on a network of relationships and integration of resources and skills among partners within the civil protection system. Among various topics, class discussions will focus on methods and problems related to the design, test, assessment and distribution of an emergency plan. This will include scenarios and simulations, warning and evacuation, search and rescue, as well as recovery and reconstruction. Special attention will be given to emergency communications and the role of information technologies. Finally, issues connected with international emergencies and the new emerging risks will be discussed.

Topics:
- Goals and extent of emergency planning
- Theory and practice of emergency planning and management
- Emergencies in industrialised and developing countries
- Sustainable development and emergency management
- Security and risk, two reciprocal concepts
- Short, medium and long term planning
- The tools of emergency planning
- Risk scenarios
- Intervention/response models
- Emergency support functions
- The emergency plan
- Testing, assessing and distributing an emergency plan
- Specialized emergency plans (crowd management)
- The reconstruction phase and the urban and environmental plan
- Mitigation and retrofitting
- Information technologies in modern emergency management
- Communications and the role of mass-media (public education)
- Operating in the international environment (UN-OCHA, UNHCR, UE-ECHO)
- The new risks

Textbooks:
Handouts and reading materials are distributed in class and available online on the course website.
D.E. Alexander. Principles of emergency planning and management. Terra publishing. Harpenden, England. 2002
S. Menoni. Pianificazione e incertezza. Elementi per la valutazione e la gestione dei rischi territoriali. Franco Angeli, Milano. 1997

S. Menoni. Costruire la prevenzione. Strategie di riduzione e mitigazione dei rischi territoriali. Pitagora Editrice, Bologna. 2005
F. Santoianni. Protezione civile – Disaster managemement. Emergenza e soccorso: pianificazione e gestione. Accursio Edizioni, Firenze 2007

COMBINED COURSE: EMERGENCY INTEGRATE MANAGEMENT
Module 2: Emergency management
(Corso integrato: Gestione integrate dell'emergenza – Modulo 2: Gestione dell'emergenza)
Dr. Susanna BALDUCCI

Aims:
The second part of the course concerns the management of the emergency, illustrating the operative actions already identified during the emergency planning, by hazard analyses and activities of forecast and prevention.
During these phases the identification of the hazard scenario allows for the project planning, by opportunely managing the residual hazard, not removed by the prevention activities.
The selected intervention model becomes the operative way to the emergency management during all its phases, the activations of simple and flexible procedures allowing for the correct coordination of the civil protection action.
The intervention direction is actuated by coordination centres and operative centres structured by different levels, depending on the event magnitude.
These centres identify the intervention strategies taking into account both the actuated plans and the real availability of human and material resources.
The civil protection operators have therefore to learn the *uncertainty* management: even when planned in details, the emergency event will be always different to what predicted.
Hence, only by an ex*haustive* emergency planning and the daily cooperation between the assistance operators and the local population it is possible to realize an adequate prevention politics and to guaranty that the procedures will become familiar for the population.
The aim of the lessons is to introduce the students to the operative procedures to actuate in the management of the different kinds of emergencies. It is remarked therefore the value of the planning as a fundamental process to activate and to induce in the civil protection operators the facility to the cooperation, in order to give the necessary fast response to the crisis.

Previous Requirements: none

Topics:

- The State of emergency: from planning to operativeness;
- Kinds of emergencies (unexpected, predictable,…)
- The Augustus method;
- Models of intervention;
- Simulations and updating of emergency plans;
- The phases of warning. The reaction to the emergency. The emergency centres.
- The utilization of operative centres and the information management. The communication about emergency conditions to the population
- Evaluation of damages. Implementation of administrative and financial management of emergency.
- Organization of the telematic and informatic support and of the logistics in emergency.
- The phases of recovery and of assistance. The reduction actions for restoring the normal conditions.
- The management of ordinary and specific emergencies.

Textbooks:
Texts and handouts given in class

COMBINED COURSE:MEDICINE OF DISASTERS
Module 1 and Module 2
(Corso integrato: Medicina delle catastrofi – Modulo 1 e Modulo 2)
Prof. M. Giovanna DANIELI

Disaster medicine is the medical specialty that studies attitudes which take in relation to an exceptional occurrence, which, although of a different nature, is characterized always to achieve a clear disproportion between the demands and response capabilities of emergency health . The aim of Medicine of Disasters: reduce the vulnerability of an environment through the development of tools for planning and organization, in times of peace, in order to reduce and eliminate in a short time, including specific health, the disproportion between the needs and capabilities response from the community involved in a catastrophic event.

Aims:
The course aims to give students the basic tools for understanding the health issues associated with a situation of disaster.
Topics:
INTRODUCTION TO DISASTER MEDICINE
HEALTH ORGANIZATION FOR DISASTER RESPONSE
MANAGEMENT OF HEALTH RESOURCES
HEALTH ISSUES IN THE TOSSICOLOGIC EMERGENCY

Textbooks:
Duplicated lecture notes

COMBINED COURSE
GEOLOGICAL AND CLIMATIC HAZARD
MODULE 1
(Corso integrato: Rischio Geologico e Climatico – Modulo 1)
Dr. Marco CATTANEO

Aims:
Knowledge of the geophysical risks, with particular emphasis on the seismic risk. Basics of seismology and seismometry. Definition of seismic hazard and seismic risk. Seismic microzonation.

Previous Requirements:

Topics:
Elements of seismology:
- dynamics of a continuous body, propagation of seismic waves, refraction and reflection, attenuation
- seismometry: seismometers, seismic networks, accelerometry
- experimental seismology: earthquake location, magnitude
- seismic sources: physics of the source, focal mechanism, seismic moment
- the real Earth: internal structure, earthquake distribution
- seismicity in Italy

Seismic hazard and risk
- recurrence statistics
- definition of seismic hazard and risk
- the Italian hazard map
- the Italian seismic classification

Volcanic risk
- elements of volcanology
- volcanic classment
- volcanic monitoring, precursors
- definition of volcanic risk

Textbooks:
Bullen, K.E., Bolt B.A.: “An introduction to the theory of seismology”. Cambridge University Press

COMBINED COURSE
GEOLOGICAL AND CLIMATIC HAZARD
MODULE 2
(Corso integrato: Rischio Geologico e Climatico – Modulo 2)
Dr. Aniello RUSSO

Aims: By the end of the course, the student will be expected to know the climatic, atmospheric and marine phenomena potentially hazardous, and basic methods of monitoring and forecasting
Previous Requirements: none; it is advisable a good knowledge of climatology and meteorology, physics and math

Topics:
Climatic hazards:
Climatic hazard and disasters. Climate change. Trends. Climate forecast and monitoring
Meteorological hazards:
Mediterranean and European mesocyclones. Tropical cyclones. Atmospheric precipitation variability. Heat Wave. Microscale phenomena. Weather forecast and monitoring
Oceanographic and marine hazard:
Characteristics and propagation of waves. Tsunami wave. Storm surge. Marine forecast and monitoring.
Adaptation

Textbooks:
Abbott, Natural Disasters V ed., Mc Graw Hill
Ahrens, Essential of Meteorology IV ed., Thomson Brooks/Cole
Wallace & Hobbs, Atmospheric Science II ed., Academic Press

PLANT PHYSIOLOGY AND BIOMONITORING
FISIOLOGIA E BIOMONITORAGGIO VEGETALE
Prof. Aurelio DE SANTIS

Aims:
The object of this course is to indicate mechanisms of plant functioning and the relationships between plant and environment. The utility of spy plant and the effect of atmospheric and soil pollutant on plant biochemistry are also developed.

Topics:
PLANT MINERAL NUTRITION: macro and micro nutrients, indexes of soil fertility, hydroponic crops.
LIGHT-PLANT INTERACTIONS: mechanisms of light harvesting; autotrophysm; photomorphogenesis and photoperiodism.
PLANT BIOMONITORING: guard plants and their utility.
BIOMONITORING AT CELLULAR LEVEL: Biochemical responses in plant as a consequence of the occurrence of atmospheric and soil pollutants.

Textbooks:
Hopkins-Hüner Plant Physiology, Wiley, International edition.

ENVIRONMENT AND CIVIL PROTECTION LEGISLATION
(Legislazione dell'ambiente e della protezione civile)
Dr. Roberto OREFICINI ROSI

Aims:
The course intends to deepen the student's knowledge of the national and international legislation on the subject of Civil and Environmental Protection. At the same time, the structures, organization and functioning of the "public administration" linked to the discussed subject matter will be reviewed. Theoretical and practical exercises will be developed to help students familiarize with the administrative procedures and activities of environmental judicial police.

Previous Requirements:
None

Topics:
Legal definition of the term environment and environmental right: the international scenery, the European and the Italian legislative framework. Environmental protection in the Constitution. The origins of the environmental right. The different levels of environmental management. Environmental Impact Assessment. The notion of environmental damage. Administrative and criminal legislation about the environment.

Rights and legislation in civil protection. The protection of the public and private safety. declaration of the state of emergency. Legislative orders of civil protection.

Textbooks: Beniamino Caravita: Diritto dell'Ambiente, Casa Editrice "Il Mulino".
Students who cannot attend classes should discuss the study material with the teacher.

ENVIRONMENTAL MODELLING (MODELLISTICA AMBIENTALE) Dr. Aniello RUSSO

Aims: By the end of the class, the student will should know the basic to numerically simulate the environmental processes and to evacuate the environmental sostenibility. Specifically, the classes should give the instruments to approach the dispersion modelling of the air pollution and its impact on the ocean and land ecosystems.

Previous Requirements: No prerequisites; it is preferable that the student would have a good knowledge of mathematics, physics and climatology.

Topics: Physical and chemical properties of atmosphere and seawater. Main concepts of fluid dynamics. Air-sea and air-land interactions. Navier-Stokes equations. The equation of continuity. Hydrostatic equation. Static stability. Turbulence. Turbulence closure. The second order moment. Reynolds theory and concept of mean. Taylor's theory. Boundary and initial conditions. Numerical models. Coupling among oceanographic and ecosystem models. Numerical methods. Air pollution. The rule and the characteristic of the advection and diffusion models and their impact with the oceans and the lands. Eulerian and Lagrangian approaches. Dispersion processes in marine and coastal areas and off-shore areas. Dispersions processes in urban areas and areas with complex orography.

Textbooks:
- S.Pond, G.L. Pickard, Introductory Dynamical Oceanography, Pergamon.
- Csanady, G.T., 1982. Turbulent Diffusion in the Environment, Reidel, Dordrecht.

ENVIRONMENTAL MUTAGENESIS (MUTAGENESI AMBIENTALE) Dr. Alessandra STRONATI

Aims:
Aim of the course is to provide a panoramic view of the various aspect of the environmental mutagenesis and in particular of the environmental genotoxic risk at which human and animals are subjected. The lessons will allow the students to acquire information concerning the basic mechanisms of transmission and expressions of genes, that are instrumental for understanding the effect and mechanisms of action of the principal genotoxic agents. The main methodologies for the genotoxic power evaluation in different substrate, will be illustrated.

Previous Requirements:
A good knowledge of Cytology, Genetics, Molecular biology, and Biochemistry is required.

Topics:
Principles of Genetics: basic knowledge on inheritance mechanisms at molecular, cell, organism and population level.
Environmental mutagenesis: The mutations. Chemical, physical and biological induction's factors. Genetic mutations: point mutation, chromosomal and genomic mutations. Dna repair. Mutagenesis test in vitro and in vivo. Genetic biomarker of exposition, effect and susceptibility. Somatic and germ cells mutation. Reproductive geno-toxicology. Mutation and cancerogenesis. Strategies of environmental monitoring of mutagens in air, water and soil. The jumping sequences of DNA: the transposons and the transgenic organisms pollutions. Ecogenetics of the molecular markers of hypersensibility to mutagens: genetic polymorphism and susceptibility. Guideline for the mutagen risk assessment and regulation.

Textbooks:
Mutagenesi ambientale a cura di Lucia Migliore Zanichelli 2004,

Griffith et al., *Genetica moderna,* Zanichelli 2000,
T.A. Brown *Genomi 2*, Edises

FIRE PREVENTION
(PREVENZIONE INCENDI)
Dr. Dino POGGIALI

Aims: Recognize the risks of fire in work places and life ambients and identify safety measures to apply for prevent fire losses and limit the effects on people and envoirement
Previous Requirements: Base knowledge on organic and inorganic chemical

Topics: A-GOALS AND FOUNDATIONS OF FIRE PREVENTION: What is to prevent fires, The process of combustion, burning of combustible materials, solid liquid and gaseous ignition processes, products and effects of Combustion, The development and spread of combustion: mathematical models , The explosions of steam, gas and dust and explosive atmospheres (ATEX), fire risk analysis, fire prevention measures to reduce the likelihood of fire, measures for fire prevention
B-TECHNOLOGY OF EQUIPMENT AND FACILITIES FOR FIRE PROTECTION: Fire integrity of structures - compartment, reaction to fire materials, Distances security systems emergency exits.
C- TECHNOLOGY FOR FIRE PROTECTION: automatic fire detection systems and fire alarm, fire extinguishing substances and portable fire extinguishers, Means and plants with extinction fixed firefighting teams and emergency planning
D-TECHNICAL RULES OF FIRE PREVENTION AND THEIR APPLICATION: Key elements of law on fire prevention and fire safety in workplaces
E- FIRE SAFETY ENGINEERING: theory and exercises
F-APPLICATIONS: Exercises for solving problems arising from the implementation of technical criteria of fire prevention on specific practical examples

Textbooks: Alberghini-Lugoboni, “Guida pratica alla prevenzione incendi e gestione dell’emergenza”, EPC Libri, La Malfa “Ingegneria della sicurezza antincendio” Edizioni Tecniche, Poggiali-Zuccaro “Analisi del rischio incendio” EPC Libri.

CHEMICAL RISK AND ECOCOMPATIBLE CHEMISTRY
(Rischio chimico e chimica ecocompatibile
To be defined

BIOLOGICAL AND ECOLOGICAL RISK
(Rischio biologico ed ecologico)
Prof. Francesco REGOLI

Aims:
The Module 1 of the Course Biological and Ecological Risk is aimed to prepare students on the more actual methodologies to assess, prevent, monitor and counteract the risk of bioterrorism. The course will also aim to prepare students on differences between biological and chemical weapons, focussing on biological mechanisms and toxicological effects. The course will also prepare students on general characteristics, diffusions, environmental resistance, infection, incubation and pathogenesis, diagnosis, bio-safety procedures. The Course will inform students on technical aspects related to planning and management of bioterroristic attacks.

Previous Requirements:
A good knowledge of basic chemistry, ecology, general and cell biology are important requisites for this course.

Topics:
Modern bioterrorism, origin and characteristics. Comparison between chemical and biological weapons. Biological weapons of type A, B, C. Main biological characteristics, diffusion, environmental resistance, infection, incubation and pathogenesis, biological mechanisms of action, clinical aspects, diagnosis and

therapies, bio-safety procedures, depuration and remediation. Type A agents: anthrax, smallpox, plague, botulism, viruses of hemorrhagic fevers, tularemia.
Chemical weapons, physical, chemical and toxicological characteristics. Primary and collateral biological effects, NOEL, LOEL, LOAEL, LC50 Ct, LCt50. General properties, stability, diffusion, exposure routes, biological mechanism of action and toxicological effects, antidotes and therapies of: blister agents, Blood agents, Nerve agents, Pulmonary agents, Incapacitating agents, Riot control agents. Planning and management of bioterroristic emergencies. Assessment of risk, critical points identification, decisional and management options. Phases of pre-triage, primary and secondary triage. Center for the control of sanitary emergencies.

Textbooks:
Provided material and scientific literature suggested on specific topics.

ENERGETIC RESOURCES AND ALTERNATIVE ENERGIES
(Risorse energetiche ed energie alternative)
Prof. Paolo PRINCIPI

Aims: Renewable energy is becoming one of the fastest growing industries in the face of the current environmental crisis, resulting from dependence on fossil fuels and unprecedented global rate of development. To the end of the instruction the student will have to know the functioning of all types of renewable energies technologies. The Renewable Energy Program gives the student a solid foundation in the fundamental design, installation techniques required to work with renewable technologies.

Previous Requirements: taken the exam of Environmental Technical Physic

Topics:
This course in the first part surveys primary energy resources (fossil, renewable, nuclear), energy conversion methods, future energy demand scenarios, and environmental impacts of energy. It presents an overview of energy policy in the word, Europe, Italy and local communities.The second part focuses on photovoltaics, passive and active solar thermal, wind, biomass, biofuels and bioenergy, microhydro, geothermal energy, tidal energy, solar architecture and the design of energy efficient housing, green building, island effect, fuel Cell Systems & Hydrogen.

INTEGRATED SYSTEMS FOR ENVIRONMENT MANAGEMENT AND REMEDIATION
(Sistemi integrati di gestione e recupero ambientale)
Dr. Francesca BEOLCHINI

Aims: At the end of the teaching course, the student will know the best available technologies for waste treatment and environment remediation, together with reference regulations

Previous Requirements: none

Topics: Waste: definitions, classification and characterisation. Waste disposal and treatment technologies: selection platforms, composting, anaerobic digestion, incineration, landfill. Regulations. Life Cycle Analysis methodology applied to waste. Management of specific classes of wastes: electric and electronic equipment waste, exhaust batteries, harbour wastes. Environment remediation: in situ/ex situ technologies for contaminated sediment, pump and treat systems and permeable reactive barriers for contaminated groundwater, remediation of contaminates soil. Industrial quantitative risk analysis. Risk analysis applied to contaminated sediments.

Textbooks:
Paul Wiliams, 2006 Waste Treatment and Disposal 2nd Ed. John Wiley.
Luca Bonomo, 2005. Bonifica di siti contaminati. McGraw Hill.

ENVIRONMENTAL SUSTAINABILITY
(Sostenibilità ambientale)
Dr. Antonio DELL'ANNO

Aims:
Provide the basic principles and the most recent approaches for managing complex and inter-disciplinary issues needed to answer environmental sustainability objectives

Topics:
Definition and basic concepts:
The concept of environmental sustainability: problems and definitions. Ecological sustainability. Sustainable development. Contrasting hypotheses. Analysis of the growing anthropogenic impact. Applications. Sustainability of environmental impact. Carrying capacity. The ecological management. Services provided by ecosystems. Evaluation of the natural capital. The key ecological paradigms (resistance, resilience, emerging properties and ecosystem borders) in the eco-sustainable of the environment. Ecosystem functioning.

Global change and global ecology:
Degradation of terrestrial ecosystem and of the landscape. Erosion in developing countries. Other forms of environmental degradation. Desertification, natural and anthropogenic deserts. Deforestation, typologies of forests, ecological role of forests. Environmental destruction. Human ecology. Human populations and urban growth. Air pollution. Water and ocean pollution.

Case studies:
Anthropogenic impact and climate change; Air quality: the case of the Amazon forest. Water cycle and water resources. Availability and quality of water: the case of NY. Agriculture and sustainable yields. Biological resources. Food quality and the sustainability of fisheries. The case of the management of fisheries in W-Africa. The aesthetic and recreational value of the environment: the case of coral reefs. Biodiversity of terrestrial and aquatic ecosystems and the production of goods and services for humans. Model of sustainable development of forest resources: the case of Canadian forests. Effects o the application of the "precautionary principle". Sustainability and conservation, sustainability and environmental recovery. Actions in USA.

Strategic approach to the use of the natural resources:
Analysis of multiple impacts in the multiple environmental dimensions. Indicators of sustainable development. Sustainable use of the resources. Ecological footprint. *Footprint* and Emergy. Planning the use of resources. Recycling and re-use. Sustainable management of biological resources (renewable). *Driving forces*, pressure, environmental health. Agriculture, Constructions, Energy, Use of non-renewable resources. Indicators of development. Definitions and individuation of the priority resources. Strategies for the abatement of the impact due to the use of resources.

Environmental sustainability:
Ecological approach in the political and social decisions. Impact of economical transformation and globalization of ecosystems. Cost-benefit analysis of these actions. Perspectives for the 2050, Global *carrying capacity* of the Earth. Biophysical characterization. Ecology of the world health. Then problem of disparities. Competitions and conflicts. Ecological priorities and prognosis.

Textbooks:
Duplicated lecture notes
G. Bologna (2008) Manuale della sostenibilità. Idee, concetti, nuove discipline capaci di futuro. Saggistica e manuali, Edizioni Ambiente.
J. Lemons, L. Westra, R. Goodland (1998) Ecological sustainability and integrity: concepts and approaches. Kluwer academic Publishers.
C. H. Southwick (1996) Global ecology in human perspective. Oxford university Press
N. Chambers, C. Simmons, M. Wackernagel (2000) Sharing nature's interest: ecological footprints as an indicator of sustainability. Earthscan, London and Sterlin, VA.

GIS INSTRUMENTS FOR CIVIL AND ENVIRONMENT PROTECTION
(Strumenti GIS nella protezione ambientale e civile)
Dr. Francesca SINI

Aims: The course introduces students to the tools and techniques of Geographic Information Systems (GIS), providing an overview of the GIS theory, related technologies and applications for civil and environmental protection.
A relevant part of the course has been reserved for practical activities and labs. Students will experience GIS instruments and issues related to the design of a GIS for the civil protection.

Previous Requirements: Cartographic and IT basic knowledge

Topics:
Part I – Geographic Information Systems Theory
An introduction to Geographical Information System (GIS); Cartography and Photogrammetry; GPS, GLONNASS and Galileo Technologies; Remote Sensing introduction-active and passive sensors; Digital Terrain Models (DTM);
Database; Telemetry and SCADA systems; Data Format; Metadata; Data Management; Data Quality; Networking; GIS architectures; Spatial Analysis and Geoprocessing; GIS Design; Open source and commercial GIS softwares;

Part II – GIS application for the environment and the Civil Protection
GIS for Civil Protection; Opensource softwares tutorial (Postgres and gvSIG); GIS training and exercises; Project development on assigned civil protection case studies;

Textbooks:
- **Gomarasca M., Elementi di Geomatica,** Associazione Italiana di Telerilevamento;
- **Atzeni P. - Ceri S. - Paraboschi S. - Torlone R., Basi di Dati,** The McGraw-Hill Companies;
- Course notes;
- Postgres Manuals (http://www.postgresql.org/docs/manuals/);
- gvSIG Manuals (http://www.gvsig.gva.es/index.php?id=manuales-gvsig&L=2).

SUSTAINABLE DEVELOPMENT AND ECOLOGICAL ECONOMICS

(Sviluppo sostenibile ed economia ecologica)

Dr. Roberto ESPOSTI

Aims:
The course is divided in four parts.
The first part aims to introduce the basic and widely used concepts and definitions of "sustainable development" from the environmental perspective. The second part aims to apply the concepts above in the empirical practice according to the prevalent international policy guidelines, and with particular attention on National Environmental Accounting and on construction of Environmental Indicators. Attention is also paid to the State of the Environment in Italy and in the EU. The third part deals with the causal relationship between the mounting processes of economic globalisation and environmental degradation with specific mention to the main issues raised by global population growth. Finally, the forth part introduces the main concepts of Ecological Economics, starting with a general description of how and when this stream emerged during the recent history of economic thought. Main ideas of key-authors in this stream of economic thought are presented with specific emphasis on Georgescu-Roegen and Daly. The ecological interpretation of the concept of "sustainable development" is eventually discussed.

Topics:

First Part: Concepts of sustainability of economic development

Sustainable economic development: introductory concepts
Weak and strong sustainability
Sustainability and economic growth models
Economic development, poverty and the environment

Second Part: Analysis of environmental sustainability
International and EU policies
National Environmental Accounting
Building Environmental Indicators of sustainability
The state of the environment in Italy and in the EU

Third Part: Globalisation and environmental sustainability
Inequality, poverty and globalisation
Environmental degradation and globalisation: the cause-effect relationship
The population growth issue

Forth Part: Ecological Economics
History of Economic Thought and the environmental question
Georgescu-Roegen and the thermodynamic theory
Daly and the steady-state
Sustainable development from an ecological point of view

Textbooks:
Of the following texts, only some specific parts will be dealt with during the course. These parts will be indicated in class as well as in the teacher website (http://www.dea.unian.it/esposti). Texts are here listed in order of relevance:

- F. Silvestri. Lezioni di economia dell'ambiente ed ecologica. II edizione. CLUEB, 2005
- S. Borghesi, A. Vercelli. La sostenibilità dello sviluppo globale. Ed. Carocci, 2005
- T. Tietenberg. Economia dell'ambiente. McGraw-Hill, 2004
- D. Verdesca. Manuale di valutazione d'impatto economico-ambientale. Maggioli Editore, 2003
- C. Cici, F. Ranghieri. La governance locale dell'ambiente e del territorio. Ed. Guerini Scientifica, 2004
- Ministero dell'Ambiente e della Tutela del Territorio. Relazione sullo stato dell'ambiente 2005, 2005 (www.minambiente.it)
- C. Böhringher, Lange, A. Applied research in environmental economics. Physica-Verlag, ZEW Economic Studies Vol. 31, 2005
- A. Quadrio Curzio, R. Zoboli. Ambiente e dinamica globale. Il Mulino, 1995