

English Version

DEGREE IN OPTICS AND OPTOMETRY

Academic Year 2008 - 2009

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ADVICE

The information reported are updated to 30th of July, 2008. Any variations will be communicated with advertisements exposed in the didactic panel. Further information can be found at the web site of Material Science Department or asking to didactic Secretary

Didactic Secretary

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Materials Science Department, via Cozzi 53, Milan.

DIDACTIC COUNCIL IN MATERIALS SCIENCE AND SECRETARY'S OFFICE

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Coordinator for the degree in Optics and Optometry:

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- **Didactic Secretary:**

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- **Office Time:**

From Monday to Friday: 9.30 - 11.30 and 14.30-15.30
Didactic information, lecture time table, thesis, plan of studies and other things

- **Student Representatives in the CCD:**

Boioli Francesca, Sosso Gabriele, Montefiori Anna, Vettigli Marco, Alberto Gregari, Riccardo Turrisi, Serena Dossena.

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Università degli Studi di Milano-Bicocca

Faculty of Mathematics, Physics, and Natural Sciences

**Degree in Optics and Optometry
Class n° L30 Physical Sciences and Technologies**

(DEGREE, DM 270/2004)

COURSE REGULATION – ACADEMIC YEAR 2008/2009

Overview

The degree in Optics and Optometry belongs to the class of degrees in physical sciences and technologies (class n°30); it is developed over a period of three years with 20 exams (including those which can be chosen by the students). It is aimed at preparing the student to adequately manage scientific topics and methods along with gaining more specific professional knowledge in optics, optometry, and contactology. At the end of the course, after the acquisition of the required 180 cfu, the students obtain a Degree in Optics and Optometry. This degree opens the possibility to the Lauree Magistrali both of the class of physical sciences and technologies and of the Faculty of Mathematics, Physics, and Natural Sciences. The inscription to these Lauree Magistrali is possible after the verification that the acquired knowledge satisfies the specific requirements, maybe also with some necessary extra-training, as decided by each didactic regulation.

In order to follow the courses successfully it is recommended and highly beneficial that the student knows and pursues the topics that interest him/her. The degree course requires the student to possess initiative and autonomy during study and to be able to cope with the scientific discipline. Furthermore, the available professional careers that are open demand a frequent contact with people, and one should recognise one's own ability to deal with public relations.

Students coming from other Degree courses or Diploma courses from this University or other colleges can be transferred to this degree course as long as the exam credits already gained are recognised by a specific commission.

Specific didactic objectives and description of the didactic plan

The Degree course is framework of the European standard scheme in the field of optics and optometry and it provides proper knowledge in the fields of classic and modern physics, solid basis of anatomy, physiology, and human and ocular histology, and chemistry. This education is completed by theoretical and practical activities in the more specific professional areas of optometry, contactology, and industrial processes for optics and optometry. In particular, the student will have the knowledge, the capabilities to understand, and the specific competences

to apply the acquired competences both to a complete optometry analysis and to use the technical supports for the solution of visual deficit. Moreover, the student will have the basis knowledge to understand the most modern and advanced techniques in optics and optometry and to use the modern instrumentation in a clinic of optometry, including the application of contact lenses.

At least one foreign Language of the European Union must be known by the students. This is fundamental for exchange of information and knowledge. Moreover, particular attention is paid to the development of the ability to work in a group, but with the required individual autonomy.

Teaching Results (DM 16/03/2007, art. 3, comma 7):

knowledge and understanding

The degree course gives the student a good training in the field of classical and modern physics, in geometrical optics, in basic human anatomy, physiology and histology along with the necessary chemistry. Each study is integrated with a combined theory and practice specifically related to the profession in optometry, contact lenses and the industrial processes which are generally used in optometry. Moreover, training in the technology dedicated to the correction of defective vision using the current tools and methodologies in optometry and contact lens development is also given.

Applying knowledge and understanding

The graduate will obtain the competence to understand and locate characteristic physiology and pathology of the visual system, also using modern and advanced instrumentation in optometry clinics, applying refractive techniques and routine functions as well as following the preliminary exams for an optometry exam. Furthermore, the student will gain training in the software used and statistics in order to treat the images obtained with modern optometry equipment.

Making judgements

The graduate will know how to use the necessary technical support in order to gain independence in the visual system and to evaluate the solutions necessary to apply to patients with defective vision especially from the technical point of view.

Communication skills

The degree course will supply the student with specific knowledge in optics and optometry of contact lens with another working knowledge of a European language essential in exchanging with other international colleagues in the field of optometry. The degree enables the student to communicate ideas, problems and solutions relevant to optometry etc and furthermore will be particularly able to work in a group and build autonomy in the necessary decision making for a future profession.

Learning skills

The preparation and competence acquired will allow the graduate in optics and optometry to easily maintain up to date since they will be able to follow the cultural and technological development of optics, optometry and contactology with the proper capability to adapt to modern changes.

Professional opportunities

As predicted by the class of physical sciences and technologies L30, the degree in Optics and Optometry enables access to small and medium sized businesses, in large optics industries, in public-sector enterprises and in production agencies and commercial products and technical instruments for the optics sector as well as for vision corrective applications. Moreover, one can pursue entrepreneurial or apprentice activities as well as having access to examinations to become a freelance professional in optics.

The positions available to a graduate in Optics and Optometry include:

- the profession of optometrist as predicted by the rules for the different professions of the ISTAT;
- professional sector: entrepreneur, freelance professional, professional in optical agencies a/o those connected to the field;
- industry sector: junior researcher a/o responsible for process and quality control (optical instruments, ophthalmic lenses and contact lenses);
- in the commercial sector: assistant to the development of client-specific products, after sales assistant (training and update courses for clients), development and marketing of optical products.

Moreover, if further and properly completed, the acquired knowledge allows to do research and teaching.

Rules for the inscription to the course

Students interested in following the course of Optics and Optometry are supposed to pass an initial test (art. 6 of the D.M. 270/04) which is aimed at verifying their initial preparation. This test is a service provided by the University, in particular by the Faculty of Mathematics, Physics, and Natural Sciences. The main subjects of the test are mathematics and logics deriving from previous school.

The test is obligatory. However, the students who will not pass this test will have to attend extra lessons with a further final test. If this exam will not be passed, other extra lessons must be attended to reach the required basic knowledge before the end of the first year of course.

Course Organization

The teaching structure of the degree course is designed taking into account the needs of the students in order to qualify in the three years allocated.

The requirements, competences, and professionalism of the student will be evaluated in training credits (CFU). These CFUs include the teaching courses and the personal study (work studies), and also other activities related to the course.

A single cfu counts for 25 hours activity including lessons, individual study, laboratory practice, placement on training courses and work experience. It corresponds to 8 hours of lessons or 16-25 hours of activities in the laboratory, stage and other activities. The remaining hours to obtain 25 is for the individual study of the student.

The teaching is distributed in modules each year between two semesters. Credits are acquired after successfully completing 20 exams to cover the curriculum in order to complete 180 cfu distributed over three years (about 60 cfu per year).

The course is divided into basic teaching and specific subjects for a total of 180 cfu in 3 years. The courses for the first, second, and third years are reported in the following tables. For each course, students must pass an exam, which can be written and/or oral depending on the decision of the teacher. The exams will be held in specific periods of the year, decided by the CCD usually at least 7 exams are distributed in periods without teaching activities, usually February, June, July and September. Lessons are also suspended in mid first semester (November) and mid second semester (May). If the teachers are available, the students of the third year can take the exams in different periods with respect to those listed above.

For now the course of Optics and Optometry has only one curriculum. At the beginning of the first semester of the second year the student must present the plan of the studies, which must be approved. If this plan coincides with the plan reported in this regulation it will be automatically accepted. The plan can also be changed in the following years. The students can propose other courses if they are coherent with the aims of the courses.

The students can choose for fulltime study with the duration of 3 years or a part time study for a duration of 6 years.

Study scheme for Fulltime students:

Code SSD	I Year	Duration	cfu
MAT/05	Basic Mathematical Analysis I	year	8
CHIM/03- CHIM/06	Chemistry	year	8
BIO/16, BIO/09	Human and Ocular Anatomy and Histology	Semester	8
FIS/01	Physics I	Year	8
FIS/01	Geometric and Ophthalmic Optics and Laboratory of Geometrical Optics and Optical Systems	Year	8
INF/01, SECS-S01	Data and Images	Year	8
BIO/09	General and Ocular Physiology	Semester	8
	Foreign Language		3
TOTAL credits I year			59

Code SSD	II Year	Durata	cfu
FIS/07	Physical Techniques for the General Optometry	Year	12
FIS/01	Physics II	Year	8
FIS/07	Optics of the General Contactology	Year	12
FIS/07	Laboratory of Physical Techniques for Optometry	Year	8
FIS/07	Laboratory of Optics of Contactology	Year	8
MAT/05	Basic Mathematical Analysis II	Year	8
FIS/08	Optical Instruments and thier Historical Evolution	Semester	4
TOTAL credits II year			60

Code SSD	III Year	Duration	cfu
FIS/07	Advanced Optometry	Semester	8
FIS/01	Physics of vision	Semester	4
MED/30	Principles of Ocular Patology	Semester	4

FIS/01	Physics III with Laboratory	Semester	8
FIS/03	Optical Properties of Materials	Semester	4
	Apprenticeship and final exam		18
	Courses chosen by the student		12
	Activities related to the professional field (Art 10, comma 5d).		3
TOTAL credis III year			61

Study scheme for part time students

Provision is made for part time students to pursue an alternative plan of study. The teaching activities are the same as for full-time inscription but with one year's full-time activities spread over two years according to the following scheme:

Code SSD	I year	Duration	cfu
MAT/05	Basic Mathematical Analysis I	Year	8
CHIM/03- CHIM/06	Chemistry	Year	8
BIO/16, BIO/09	Human and Ocular Anatomy and Histology	Semester	8
FIS/01	Physics I	year	8
TOTAL credits I year			32

Code SSD	II year	Duration	cfu
FIS/01	Geometric and Ophthalmic Optics and Laboratory of Geometrical Optics and Optical Systems	Year	8
INF/01, SECS-S01	Data and Images	Year	8
BIO/09	General and Ocular Physiology	Semester	8
	Foreign Language		3
TOTAL credits II year			27

Code SSD	III year	Duration	cfu
FIS/07	Physical Techniques for the General Optometry	Year	12
FIS/07	Laboratory of Physical Techniques for Optometry	Year	8
MAT/05	Basic Mathematical Analysis I	year	8
TOTAL credits III year			28

Code SSD	IV year	Durataion	cfu
FIS/01	Physics II	Year	8
FIS/07	Optics of the General Contactology	Year	12
FIS/07	Laboratory of the Optics of Contactology	Year	8
FIS/08	Optical Instruments and thier Historical Evolution	Semester	4
TOTAL credits IV year			32

Codice SSD	V year	Duration	cfu
FIS/07	Advanced Optometry	Semester	8

MED/30	Principles of Ocular Patology	Semester	4
FIS/01	Physics III with Laboratory	Semester	8
	Courses chosen by the student		12
TOTAL credits V year			32

Code SSD	VI year	Duration	cfu
FIS/01	Physics of vision	Semester	4
FIS/03	Optical Properties of Materials	Semester	4
	Apprenticeship and final exam		18
	Activities related to the professional field (Art 10, comma 5d).		3
TOTAL credits VI year			29

Obligatory courses:

The following courses must be attended by the students: laboratory of geometrical optics and optical systems, laboratory of physical techniques for optometry, laboratory of optics of contactology, laboratory of physics III, laboratory of advanced optometry. The credits of the foreign language corresponds to 3 cfu and students are expected to pass an exam. If this exam is not passed, the students cannot go further to pursue the exams in the second and third years. For the inscription to the second year the student must have at least 20 cfu. For inscription to the third year the student must have 50 cfu.

Prior requisites to enter courses:

To enlist for:

Basic Mathematical Analysis II
 Physics II
 General and Ocular Physiology
 Physics III
 Optical Properties of Materials
 Physics of vision
 Principles of Ocular Pathology
 Advanced Optometry

Exams needed to be passed:

Basic Mathematical Analysis I
 Physics I
 Human and Ocular Anatomy and Histology
 Physics II
 Physics II
 Physics II
 General and Ocular Physiology
 Physical Techniques for the General
 Optometry

Teaching activities chosen by students: 12 CFU

The student can choose from a list of teaching activities from different study courses at the college (applies to both new and old systems) for a total of 12 cfu. If the student choose courses among those suggested, the plan of studies is automatically approved, otherwise they must be approved by the CCD.

Work placement, stage or apprenticeship

Work experience takes place either externally or internal to the main University:

External work experience

Consists of an activity in the field of optics a/o optometry chosen by the student at nearby enterprises, public or private businesses, under the guidance of an external representative and personal tutor from the host institute.

Internal apprenticeship

Consists of an activity in the field of optics a/o optometry chosen by the student nearby the Science Faculty MM FF NN and Medicine of the main University at nearby enterprises under the guidance of a supervisor and eventually with a second co-supervisor.

Official supervisors

An external supervisor, or company representative where the placement is held, who consults with the degree course committee in order that the assigned activities are fitting and adapted to the student's career development.

An internal supervisor (or tutor) is responsible for the student's course structure and work experience. The internal supervisor can be a permanent lecturer or researcher of the Faculty of Mathematics, Physics, and Natural Sciences or of the Medicine Faculty.

Co-supervisors

The co-supervisor can be all lecturers included in the Official supervisor's category, and also post-graduates who are familiar to the field of study a/o specialists with proven experience.

Conditions for work placement (Stage or apprenticeship)

To be eligible for work experience, the student must have achieved a minimum of 132 cfus. The following exams must have been passed in order to pursue work experience in optics: geometric optics, laboratory of geometric optics and optical systems, Physics II, whilst for work placement in the field of optometry, the student must have successfully attained exams in physical techniques for general optometry, laboratory of physical techniques for optometry, general optics of contactology, laboratory of the optics of contactology, general and ocular physiology. The request for a placement must be approved by the CCD as well as the commission for theses and work placements.

Duration of work placement (Stage, or apprenticeship)

Both internal and external work placements have a duration of 400 hours.

Frequency of work placement activity

The timetabling of the work experience is decided between the student and his/her internal a/o external supervisor.

Admissions for work placement (external apprenticeship)

To be eligible for a work placement, all relevant documentation should be completed and presented to the Course Secretary a month in advance of the expected placement. The request for work placement is also accepted from students who do not meet the required number of cfus necessary for admission in order that they improve their situation before the starting date of the work placement. Students who find themselves in this position must inform the President of the commission for work placements when they have completed the remaining cfus. At the end of the work experience, the student will gain credits according to attendance, personal application to study and achievement of assignments that the supervisor will assess. A certificate of attendance during the work placement term must be signed by the supervisor and co-supervisor for internal work placement and by the external supervisor for external work placements.

Places for external apprenticeships:

Clinical Centres

- CLINICA SAN SIRO (MI)
- CLINICA SANT'ANNA (Brescia)
- CLINICA COLUMBUS (MI)
- ILMO (Istituto Laser Microchirurgia Oculare)
- Policlinico di Monza
- Centro Oftalmo-Chirurgico Carones
- OSPEDALI RIUNITI DI BERGAMO
- Centro di Analisi Mediche - C.A.M. - Monza (MI)
- Istituto Scientifico "Eugenio Medea" Bosiso Parini (LC)

Enterprises

- ZEISS-ITALIA (MI)
- OPTOKONTACT (NO)
- GIOVANZANA MARIO (MI)
- SEIKO AVANT ITALIANA (MI)
- FONDAZIONE IARD
- CENTRI CLINICI OPTOMETRICI (CONVENZIONE CON FEDEROTTICA)
- EIKON sas (Fi)
- SALMOIRAGHI E VIGANÓ' (MI)
- BELOTTI OTTICA & UDITO, CH-6500 Bellinzona (TI)
- STUDIO VISTA CASSANO MAGNAGO (VA)
- CIBA VISION Srl, MARCON (VE)

For further information consult the web site www2.mater.unimib.it/MANIF_OTTICI.HTM.

Final Examination

To be admitted for the final examination, the student must have completed all the leading examinations during the course of study, including the foreign language knowledge test that counts for 3 cfu.

The remaining cfus required to complete 180 cfu in order to graduate are gained by the stage or apprenticeship and in the final examination that consists of a discussion of a written report made by the student of the work experience period under the guidance of the supervisor. Concerning the form of examination: if the work placement was of a training nature in a particular field, the final examination will be based on a discussion of the student's written report of their experience during the period approved by the internal supervisor and external supervisor. If the work placement activity was of a theoretical or experimental nature under supervision by a member of the Faculty, the final examination consists of an oral discussion of a written report made by the student of the results achieved and approved by supervisor.

The examination will take place in a public sitting in front of a jury of teachers. The final degree evaluation will be expressed in 1/110 fractions (with possible honours), as obtained by making an average of the evaluations of the three years activities which are expressed in 1/30 fractions, weighted according to the number of credits attached to each activity.

The diploma will be awarded indicating the degree obtained in Optics and Optometry, the class of degree it belongs to which is Physical Sciences and Technologies, with the classification number.

Recognition of the cfu and transfer rules

Transfer can be requested by students of other course of the same university or from other universities. The student can ask for recognition of the credits obtained with other courses which must be accepted by the CCD. It is possible to ask for the recognition of credits for those courses which are not strictly related to optics and optometry as credits chosen by the student. As far as the credits related to certificated knowledge and professional competences are concerned and as far as those activities realised together with the university are concerned, as predicted by Art. 5, comma 7 of D.M. 22 October 2004 N. 270, the course in Optics and Optometry has fixed a maximum of 40 cfus. In any case also these cfus must be accepted by the CCD.

Teachers of the course

The teachers of the course in agreement with art. 1, comma 9 of the D.M. 16 March 2007 are: Dimitri Batani, Andrea Becchetti, Alessandro Borghesi, Livia Giordano, Marzia Lecchi, Marco Martini, Stefano Miglior, Antonio Papagni, Adele Sassella, Raimondo Schettini, Silvia Tavazzi, Riccardo Tubino, Anna Vedda.

International Mobility

Commission for international mobility:

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Other information

For the inscriptions, transfers, plans of study and so on, consult the web site www.unimib.it.

Further information can also be found at:

Dipartimento di Scienza dei Materiali, Ed. U5, Via R. Cozzi 53, 20125 Milan.

- Didactic Secretary
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web site: [http:// www.mater.unimib.it/didattica.htm](http://www.mater.unimib.it/didattica.htm) oppure www.unimib.it

or

- Prof. Antonio Papagni
Supervisor of the degree in Optics and Optometry
Tel. 02.6448.5234
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CONTENT OF THE UNDERGRADUATE TEACHING COURSES FOR OPTICS AND OPTOMETRY

I YEAR (59 cfu)

BASIC MATHEMATICAL ANALYSIS I – 8 cfu

Lecturer: Prof. Luigi Fontana

luigi.fontana@unimib.it

Course Description:

1. Numbers: naturals, integers, rationals, reals.
2. The concept of function. Elementary functions: powers, exponential, logarithm, trigonometric functions.
3. The concept of limit. Elementary limits, indeterminate forms, fundamental limits. Asymptotic symbol and its use.
4. Continuous functions. Points of discontinuity.
5. The Derivative. Computation of derivatives. Points of non derivability.
6. Theorems about differentiable functions: Fermat, Rolle, Lagrange.
7. L'Hospital's Theorem and computation of limits. Taylor's formula.
8. Riemann Integral and area of regions in the plane. Integration of continuous functions.
9. Fundamental Theorem of Calculus
10. Integration by parts and by substitution. Computation of antiderivatives for some classes of functions.
11. Improper Integrals
12. First order ordinary differential equations. Cauchy problem. Separable variables equations and first order linear equations. Constant coefficients second order equations

Textbooks: J. Stewart "Calcolo" vol I, Apogeeonline, Milano

Examination: written and oral exam

CHEMISTRY – 8 cfu

I Modulus: General and Inorganic Chemistry - 4 cfu

II Modulus: Organic Chemistry - 4 cfu

Lecturers:

I modulus: Dott.sa. Livia Giordano

livia.giordano@unimib.it

II modulus: Prof. Antonio Papagni

antonio.papagni@unimib.it

Course Description:

I modulus

- A) Matter: atoms and molecules. Stoichiometry: chemical compounds, chemical formulas and equations. Atomic mass units, mole and molar mass. Nomenclature for binary and ternary compounds.
- B) Electrons, orbitals and polyelectronic atoms. The periodic table of the elements: periodicity of chemical properties.
- C) The chemical bond: ionic and covalent bonds. Lewis octet rule. Hybrid and molecular orbitals. Molecular geometry (VSEPR model).

- D) Aqueous solutions. Concentration of a solution (mass %, molarity, ppm).
- E) The chemical equilibrium. Mass action law and Le Chatelier's principle. The equilibrium constant. Acid/bases theories. pH of solutions. Titrations and indicators. Buffer solutions.
- F) Solubility equilibria. Coordination compounds.
- H) Chemical kinetics. Velocity equations for chemical reactions. Activation energy and catalysts.
- G) Redox reactions.
- H) Chemical kinetics. Velocity equations for chemical reactions. Activation energy and catalysts.

II modulus

General aspects and introduction to Organic Chemistry.

Nature and type of the chemical bond: hybridization, molecular orbitals, electronic delocalisation and aromaticity concept, structure and molecular formula, type of molecule representations.

Isomery: structural, configurational, conformational and stereoisomery, concept of stereogenic element.

Chirality: optical purity and activity, diastereo and enantiomorphism; Cahn-Ingold-Prelog rules, descriptors used for discriminating stereoisomers.

Functional groups: concept and type of reactivities (electrophile, nucleophile and radical concept); classification of the organic compounds.

Nomenclature, physic, chemical, and reactivity properties of principal organic compounds and their preparation: aliphatic, unsaturated and aromatic hydrocarbons; halogen derivatives, alcohols and polyols (sugars), ethers, amines, aldehydes, ketons, carboxylic acids and their derivatives (esters, amides nitriles). Mention on cyclic molecules, heterocycles, aminoacids, proteins and nucleic bases.

Surfactants and organic detergents. Mention on chemistry of the vision.

Examination: written and oral exam.

HUMAN AND OCULAR ANATOMY AND HISTOLOGY - 8 cfu

I Modulus: Human Cytology and histology - 2 cfu

II Modulus: Human Anatomy and Ocular Histology - 6 cfu

Lecturers:

I modulus: Prof. Laura Maria Rigamonti

lauramaria.rigamonti@unimib.it

II modulus: Prof. Guido Cavaletti

guido.cavaletti@unimib.it

Description of the course:

I modulus

Aim: To provide an understanding of the microscopic and submicroscopic structure of the human cells and tissues, their interactions and functional implications.

CYTOLOGY

Methods of study.

General considerations of the cell: cell form, cell size, cell life and cell death.

Structure, ultrastructure, chemical and physical properties of the following cellular organelles: cell membrane - cytoplasmic matrix - cytoskeleton - ribosomes - endoplasmic reticulum - Golgi apparatus - lysosomes - peroxisomes - mitochondria - cytoplasmic inclusions - nuclear envelope - nucleus - nucleolus.

Activities of living cells: cell division, cell locomotion, endocytosis, exocytosis.

HISTOLOGY

Methods of study.

Morphology, classification, functional properties and locations of the following tissues:
Epithelium - Connective Tissue (loose and dense connective tissues) – Adipose Tissue –
Cartilage – Bone – Blood – Muscular Tissue - Nervous Tissue.

II modulus

HUMAN ANATOMY

General morphology of human body: terminology and anatomical co-ordinates.

Classification of organs and their structural schemes. Morpho-functional aspects of different apparatuses and systems in the human body.

The common integument: structure of the skin and glands.

The locomotion apparatus: classification of bones, joints and muscles. The vertebral column: general characteristics of a vertebra. The skull: the cranial bones.

General organization of the digestive apparatus and of the urogenital apparatus.

The respiratory apparatus: the lungs.

The cardiovascular apparatus: the heart and the structure of vessels. General organization of the vascular system.. The lymphatic system and bone marrow.

The endocrine apparatus: the hypophysis cerebri, the thyroid gland, the suprarenal glands and the Langerhans islets.

Nervous apparatus: organization of nervous tissue. Ultrastructure of neuron, fiber and synapse. General organization of central and peripheral nervous systems, the organs of the senses. Structure of grey and white matter, ganglia and nerves.

OCULAR ANATOMY

The structure of the skull, with particular reference to the orbital bones and to the base.

The facial muscles, with particular reference to the extraocular muscles of the orbits and to the intrinsic muscles of the eye.

General aspects of the pulmonary and systemic blood circulation.

The arterial and venous blood supply to the head-and-neck region, with particular reference to the vascular aspect of the orbital region.

General aspects of the embryology of the nervous system and of the eye.

Morphological aspects and functional organization of the central and peripheral nervous system, with particular reference to the following aspects:

- anatomy of the optic pathway
- the control of voluntary and reflex oculomotion
- structure and function of the peripheral nerves
- anatomical organization and functioning of the cranial nerves, with particular reference to the II, III, IV, V, VI, VII and VIII nerves

The orbital region.

The eyeball: structure and organization.

Anatomo-functional correlation.

Textbooks:

I modulus

Autori Vari (Calligaro) – Citologia e Istologia Funzionale – edi.ermes

Autori Vari (Castano) – Anatomia dell'Uomo – edi.ermes

II modulus

Autori Vari (Castano) – Anatomia dell'Uomo – edi.ermes,

Martini Timmons Tallitsch –Anatomia Umana – EdiSES

Examination: written and oral exam

GENERAL AN OCULAR PHYSIOLOGY - 8 cfu

I Modulus: General Physiology

II Modulus: Ocular Physiology

Lecturers:

I modulus: Prof. Andrea Becchetti

andrea.becchetti@unimib.it

II modulus: Dott.ssa Marzia Lecchi

marzia.lecchi1@unimib.it

Description of the course:

I Modulus

Principles of Biochemistry

Cellular energetics, enzymes, anaerobic and aerobic cell metabolism.

General Physiology

Fundamentals: plasma membrane; simple diffusion; active and passive membrane transport. Water fluxes. Transepithelial transport. Exo- and endocytosis.

Excitable membranes: membrane potential and resting potential; passive properties and propagation; action potential and voltage-dependent ion channels; action potential propagation.

Cellular communication: electrical and chemical synapses; neuromuscular junction; excitatory and inhibitory synapses; neurotransmitters and neuropeptides; introduction to intracellular signaling; endocrine mechanisms.

Muscle contraction: electromechanical coupling and contraction in striate and smooth muscle. Principal types of striate fibres.

System Physiology

Principles of neurophysiology: synaptic integration, simple neuronal circuits. Sensory systems: signal transduction and coding, somatosensory system, chemoception, proprioception.

Motor systems: spinal cord and simple reflex arcs, elements of cerebellar structure and function.

Autonomic nervous system: ortho- and parasympathetic sections (neurotransmitters and receptors, autonomic reflexes).

Exocrine glands: primary secretion and duct reabsorption. Neuroendocrine control.

Cardiovascular physiology: hemodynamics, systemic and pulmonary circulation. Cardiac cycle, autonomic modulation of pacemaker activity. Peripheral circulation: arteries and veins, microcirculation, local and neuroendocrine control.

Respiratory system: gas transport, respiratory pigments, modulation of Hb affinity for oxygen. Gas exchange in lungs and tissues. Neural control. Blood pH.

II modulus:

Visual Physiology.

Complements of sensory physiology: balance and hearing. Coding and transmission of retinal information: rods and cones; phototransduction; intraretinal elaboration, horizontal, bipolar and amacrine cells. Integrative function of ganglion cells, frequency, receptive fields. Scotopic and photopic vision. Adaptation. Chromatic vision and main defect. Detachment.

Visual information analysis: visual pathways and areas; binocular vision and visual fields; cerebral treatment of contrast, orientation, form, movement and spatial localization. Stereoscopy.

Light stimulus.

Solar and visible spectrum; transmittance of ocular media; preretinal absorption; ocular damage by radiation.

Retinal image formation.

The eye as an optical system: overall properties, contribution of cornea and lens. Defects and spontaneous corrections; development and aging; visual acuity.

Cornea: structural and biochemical and optical features; layers; transparency and hydration, metabolic requirements for maintenance; hydrophily, thickness variation, edema; tension and stability in relation to ocular pressure.

Sclera: structural and functional properties; wall equilibrium and ocular pressure.

Cristalline lens: structure, composition, biochemical and metabolic properties; refraction; accommodation: features, control, defects; drug effects on accommodation; transparency alterations, aging.

Iris: function and motility; pupillary aperture control; response to light; main alterations.

Vitreous body: volume and functions; composition, biochemical and metabolic features.

Eye nutrition.

Circulation: uveal and retinal systems: distribution and capillary permeability; perfusion pressures, fluxes; hemato-ocular barrier; formation and exchange of interstitial fluids.

Endo-ocular pressure: normal values, circadian fluctuations; production and efflux of aqueous humour; effects of endo-ocular pressure on circulation and nutrition; oculo-cardiac reflex.

Aqueous humour: composition and functions; volume, renewal, formation, efflux.

Protection apparatus

Eyelids: functions, motility and its control; bulbar movements.

Lacrymal secretion: functions, physical properties, layer thickness; secretion and its control; basal and reflex secretion; excretion; alterations of secretion and excretion.

Motility: extrinsic muscles: properties and innervation; ocular movements.

Textbooks

I modulus:

- RANDALL et al. "Animal Physiology", Freeman, 2004.
- GERMANN, STANFIELD, "Human Physiology", italian ed: EdiSES, 2005.

II modulus:

In italian:

- PALIAGA G.P. "I Vizi di Refrazione", MINERVA MEDICA, 1995
- SARAUX H., BIAIS B. "Manuale di Fisiologia Oculare" MASSON ITALIA ED. 1986
- GUYTON A.C., HALL J.E., "Fisiologia Medica" EDISES 2002: capp. 49,50,51.
- GUYTON A.C., "Neuroscienze" PICCIN 1996: capp.: 11,12,13; pp.: 154-192.
- MARGARIA R., DE CARO L., "Principi di Fisiologia Umana" VALLARDI 1971: cap. XIII, pp:1073-1134.
- KANDEL et al., Principi di Neuroscienze, CEA, 2003. Capp. 25-29.

In english:

- KAUFMAN P.L., ALM A. "Adler's Physiology of the Eye" MOSBY 2003
- KANDEL E.R., SCHWARTZ J.H., JESSEL T.M., "Principles of Neuroscience" McGraw-Hill, 2000, chapters 25-29.

Examination: oral.

PHYSICS I – 8 cfu

Lecturer: Prof. Adele Sassella

adele.sassella@mater.unimib

Description of the course:

This course is intended to instruct the student, who has already followed the course in analytical mathematics, in the principles of classical mechanics in mind to develop an intuition in physics and to resolve problems analytically.

- Introduction

Units of measurement – conversion of units – orders of magnitude – vectors – vector algebra

- Kinetics

Motion and velocity – trajectories – instantaneous velocity – acceleration – vectors of motion – vectors of acceleration- motion with constant acceleration - motion of projectiles – circular motion - centripetal acceleration.

- Dynamics

Principles of inertia – Forces and mass – Newton's Laws – Newton's third law and the conservation of momentum – Fundamental interactions –Contact forces - forces of attraction and repulsion – static equilibrium of rigid body

- Work and Energy

Work calculated from resultant forces> kinetic energy – Work calculated from a variable force – potential energy- conservative and non conservative forces- Power – Conservation of energy – Qualitative description of motion using the conservation of energy

- Systems of Particles

Momentum of the center of mass of a system – conservation of momentum – energy of a system of particles – impacts in one and two dimensions- impulse and time-average of a force – systems of variable masses - momentum of a rocket

- Rotation of a rigid body

Angular velocity and angular acceleration – moments of a force and moments of inertia

-Calculation of moments of inertia – Theorem of parallel axes of a flat body – angular momentum of a particle – angular momentum of a system of particles

Conservation of angular momentum

- Oscillations

Simple harmonic motion – circular motion and simple harmonic motion – simple pendulum – physical pendulum – damped oscillations – forced oscillator - resonance {waves}

- Gravitation

Kepler's Laws – acceleration of the moon and other satellites- Cavendish's experiment- gravitational field

- Fluid mechanics

Density – pressure – Archimedes Principle – Surface tension and capillary action – Bernoulli's Equation – Torricelli Barometer – Viscosity - Poiseuille's equation - equation of sedimentation

- Wave motion

Impulse waves – wave velocity – harmonic waves – stationary waves of a string – stationary sound waves – energy and intensity of harmonic waves – superposition and interference of harmonic waves

- Temperature

Variation in macroscopic state – thermodynamic equilibrium – principle of absolute zero – temperature scales – distribution and molecular motion in a perfect gas.

First and second laws of thermodynamics.

Textbook: W.E. Gettys, F.J. Keller, M.J. Skove, *Fisica classica e moderna. 1. Meccanica, termodinamica, onde.* (McGraw Hill, Milano, 1998)

Examination: written and oral exam. After passing the written exam, the students can give the following oral exam or the next one.

GEOMETRICAL AND OPHTHALMIC OPTICS AND LABORATORY OF GEOMETRICAL OPTICS AND OPTICAL SYSTEMS – 8 cfu

I Modulus: Geometric and Ophthalmics Optics – 5 cfu

II Modulus: Laboratory of Geometrical Optics and Optical Systems – 3 cfu

Lecturers:

I modulus: Prof. Dimitri Batani

batani@mib.infn.it

II modulus: Dott.ssa Silvia Tavazzi

silvia.tavazzi@unimib.it

Description of the course:

I modulus

First Part: Introduction: the nature of light

Fundamental laws of geometrical optics; Newton's particle model; Huygens' wave model; Diffraction, Fermat's principle; Modern views on the nature of light: Electromagnetic waves and photons; Measurement of the velocity of light: Romer's method, Fizeau's experiment.

Second Part: Photometry

Concept of solid angle; Photometry for point sources: intensity, flux, exposure; Visibility curve; Mechanical equivalent of light; Photometry for extended sources: brightness, Lambert's law and its meaning.

Third Part: Optics of spherical surfaces

Paraxial approximation; Spherical mirrors, Dioptra, Thin spherical lenses; Formula for the focusing length; Classification of lenses; Graph of p vs q and its meaning; Convergence and divergence of a light beam; Power of a lens; Newton's and Gauss' notation. Transversal magnification, Longitudinal magnification, Angular Magnification; Lagrange-Helmholtz's theorem; Numerical aperture of a lens and f -number ($F\#$); Diaphragm, Entrance and exit pupil; Field of vision, depth of focus, resolution of an optical system; Magnification of an optical instrument;

Distance of optimal vision; Magnifying glass.

Fourth part: Thick lenses and systems of lenses

Focal distance for a thick lenses; Gullstrand's formula; Principal and Nodal Points and Planes; Formula for the distance between the principal point and the vertex; Nominal and effective power, Frontal power of a thick lens; Lens combination; Kepler and Galileo's telescopes; Parallel beam transport; Vignetting; Microscope.

Fifth part: The human eye

The human eye as an optical system; model of the eye; Cornea and lens power; Accommodation in the human eye and in a camera; Vision of an object at the optimal close distance and at infinite; Resolution of the human eye.

Sixth part: Geometrical aberrations

Aberrations due to large beams, aberrations due to inclined beams; Spherical aberrations, principal spherical aberrations; Circle of minimal confusion; Caustics; Position and Shape Coddington's factors; Minimization of spherical aberration; Correction of spherical

aberrations with a doublet; Coma, Minimization of coma; Astigmatism for inclined beams; Astigmatism due to the asymmetry in the optical system; Cylindrical lenses; Curvature of image plane; Image distortion, Aspheric surfaces.

Seventh part: Dispersion of light and chromatic aberrations

Dispersion of light; Cauchy's formula and Abbe's factor; Prisms; Minimal deviation; Astigmatism of prisms and flat plates; Achromatic Prisms; Direct vision prisms; Chromatic aberrations for positive and negative lenses; Correction of chromatic aberrations with a doublet; Formula for the power of the two lenses in an achromatic doublet.

II modulus

The Course consists of sessions, where groups of three or four students carry out some experiments devoted to verifying and studying phenomena of geometric optics. The topics of the different sessions are:

Reflection of light: plane, concave, and convex mirrors

Reflection of light: relationship between object and image

Refraction of light: refractive index, Snell's law, total internal reflection

Refraction of light: parallel interfaces, dispersion of light

Refraction of light: prism, prismatic deviation, dispersion of light

Convergent optical lenses

Divergent optical lenses

Lens aberrations.

Multiple lenses

Eye, defects, and corrections

Photometry

Lensometer

Textbooks:

- G.S.Landsberg "Ottica" Edizioni MIRMosca 1979

- J.R. Meyer-arendt "Introduzione all'ottica classica e moderna" Zanichelli, Bologna, 1976

- *notes given in the laboratori*

Examination: written and oral exam and report of some practical experiences.

DATA AND IMAGES – 8 cfu

I modulus: Data - 4 cfu

II Modulus: Images - 4 cfu

Lcturers:

I modulus: Prof. Marco Martini

marco.martini@unimib.it

II modulus: Prof. Raimondo Schettini

schettini@disco.unimib.it

Description of the course:

I modulus:

- Preliminary description of errors analysis.

The importance of errors theory and the evaluation of errors.

- How representing and using the errors.

Best value +/- error; significative digits; comparison between measured and accepted values; comparison between two measurements; verification of the proportionality by plots; relative errorsrelative.

– Propagation of errors: sum and differences, products and division; other functions of a variable and general formula for the propoagation of errors.

- Statistical analysis of random errors. The average and the standard deviation; the

standard deviation of the average.

- The normal distribution. Limit distributions.
- The method of Chauvenet. Weighted average: combining different measurements.
- Methods of the squared minima. Linear dependences. The binomial distribution.
- Definition and properties of the binomial distribution.
- Definition and properties of the Poisson distribution.
- The test of the squared chi for a distribution.

II modulus:

The course provides the theoretical and practical basis of the image elaboration, with particular relevance to the acquisition, measurements, elaboration, and reproduction of the colour.

The program includes:

Basic information on human and artificial vision, the colour.

Introduction to the elaboration, analysis, and classification of the images.

Acquisition and digitalization of the images.

Image improvement.

Spatial filtering.

Colorimetry

Elaboration and reproduction of coloured images.

Color Management Systems, CMS; associated standards.

Textbooks:

I modulus

J.R. Taylor, *Introduzione all'analisi degli errori*, ed. Zanichelli (1998)

II modulus

R. Gonzalez, R. Woods, *Digital Image Processing*, Second Edition, 2002. Prentice Hall.

<http://www.imageprocessingbook.com/>

Notes given by the lecturer

Examination: report, written and oral exams

II YEAR (60 cfu)

BASIC MATHEMATICS ANALYSIS II – 8 cfu

Lecturer: Prof. Marina Di Natale

marina.dinatale@unimib.it

Description of the course:

Infinite series. Geometric series. Convergence tests. Representation of functions. Power series and Taylor series. Trigonometric series and Fourier series.

Linear algebra. Vectors in the plane and in the space: representation, operations, linear independence and bases. Lines and planes in the space. Matrices: operations, determinant, rank, inverse matrix. Linear transformations. Systems of linear equations. Eigenvalues and eigenvectors.

Real and vector-valued functions of several variables. Limits and continuity. Differential calculus for real functions of several variables. Directional and partial derivatives, gradient vector. Differentiability and linear approximation. Local maxima and minima. Vector-valued functions: derivatives and differentiability.

Plane curves and space curves. Arc length. Line integrals.

Multiple integrals. Reduction formulas for double and triple integrals over intervals and simple domains. Change of variables: polar, spherical and cylindrical coordinates.

Examination: written and oral proof

PHYSICS II – 8 cfu

Lecturer: Prof. Alessandro Borghesi

alessandro.borghesi@mater.unimib.it

Description of the course:

Electrostatics: Electric charge. Electric field. Flux of the electric field and Gauss theorem.

Electrostatic potential and electrostatic potential energy. Equipotential surfaces. Electric dipole.

Condensers and dielectrics: Capacity. Condensers. Energy density of the electric field.

Dielectric materials and dielectric constant.

Current and resistance: Electric current and current density. Resistance, resistivity and conductivity. Ohm law.

Magnetism: Magnetic field. Lorentz force. Hall effect. Magnetic forces. Magnetic dipole. Biot-Savart law. Ampere law. Magnetic induction. Faraday law and Lenz law. Magnetization.

Diamagnetic, paramagnetic and ferromagnetic materials. Energy density of the magnetic field.

Maxwell equations and induced magnetic field.

Suggested textbooks:

D. Halliday, R. Resnick e K.S. Krane - Fisica 2 - Casa Editrice Ambrosiana.

M. Guzzi – Esercizi di Fisica Generale II – Edizioni CUSL

Examination: written and oral

OPTICAL INSTRUMENTS AND THEIR HISTORICAL EVOLUTION – 4 cfu

Lecturer: Prof. Giuliano Bellodi (a.a. 200/208)

Description of the course:

General aspects of the optical instruments. Optical instruments: lenses, double bared, ocular and objective

Instruments for distance: astronomical telescope (Keplerian), terrestrial telescopes (Galileo), binoculars, telescopes, historical evolution

Instruments for close observation and historical evolution: microscopes, binocular microscopes, stereoscopic microscopes, electron microscopes, phoropter, ottotypes, autorefractor/autoker topograf.

History, description, functions, techniques of observation and use of optometric instruments: interpupillometer direct ophthalmoscope, ophthalmic retinoscope, keratometer, keratometry, biomicroscope, frontofocometer, crossed cylinders, autorefractometer/autocherotometer, topograph, pachimeter.

Diagnostic instruments for electrophysiology, fieldmeasure, perimeter, tonometer and retinal photography, indirect binocular ophthalmoscope, lenses and Goldmann mirrors,

Examination: report and oral exam

PHYSICAL TECHNIQUES FOR THE GENERAL OPTOMETRY – 12 cfu

I modulus - 6 cfu

II modulus – 6 cfu

Lecturers:

I modulus: Prof. Luca Giorgetti (a.a. 2007/2008)

otticagiorgetti@infinito.it

II modulus: Prof.ssa Rossella Fonte (a.a. 2007/2008)

rossefon@tin.it

Description of the course:

I modulus

METHODS OF MEASUREMENT OF THE EYE

- Catoptric images;
- Ophthalmophacometer;
- X-rays;
- Ultrasonic measurement.

REFRACTIVE STATUS OF THE EYE

- Definition and classification;
- Emmetropia and ametropia;
- Evolution of the refractive state: change of the refraction in childhood and in the adult;
- Variation of the refractive state: the incidence, nature and inheritance of refractive errors;

OPTICAL DEFECTS OF THE EYE

- Shape of the cornea;
- Shape and refraction index of the lens;
- Coaxial position of the optical elements;
- Aberrations of the optical system of the eye;
- Depth of focus.

ACCOMODATION AND PRESBYOPIA

- History;
- Mechanism of accommodation;
- Observation on the living eye;
- Range and amplitude of accommodation;
- Age changes;
- Theory of accommodation;
- Neurophysiology of accommodation;
- State of accommodation in absence of stimuli;
- Accommodation types;

- Near point of accommodation, far point of accommodation;
- Relative accommodation;
- Anomalies of accommodation: fatigue of accommodation, spasm of accommodation, insufficiency of accommodation, accommodative inertia, paralysis of accommodation;

CONVERGENCE

- Eyes movements: versions and vergences;
- Types of convergence;
- Tonic, accommodative, fusional and proximal convergence;
- Measurement of convergence;

HETEROPHORIA

- General considerations;
- Fixation disparity;
- Etiology of heterophoria;
- Types of heterophoria;
- Diagnosis and measurement of heterophoria;
- Symptoms of heterophoria;
- Treatment of heterophoria.

RELATION BETWEEN ACCOMODATION AND CONVERGENCE

- History;
- AC/A ratio;
- Estimation of the ratio

LENSES AND REFRACTIVE CONDITIONS

- Refractive condition, far point of the eye and correction lens;
- Examination of the refractive status of the eye, instruments and lenses.

MYOPIA

- Etiology and development;
- Classifications;
- Pseudo myopia;
- Nocturnal myopia;
- Myopia and heterophoria;
- Pathological and transitory myopia;
- Correction.

HYPEROPIA

- Etiology and development;
- Classifications;
- Clinical consideration;
- Hyperopia and heterophoria;
- Correction.

ASTIGMATISM

- Etiology and development;
- Classifications;
- Variations;
- Images;
- Clinical considerations;
- Vision;
- Correction.

ANISOMETROPIA AND ANISEIKONIA

- Anisometropia;

- Aniseikonia;

II modulus

1. Introduction to eye exam :

- The format of the primary eye care examination
- Patient-centred optometry and communication skills
- The case history

2. assessment of visual function

- distance visual acuity using logMar char
- distance visual acuity using Snellen chart
- Near vision acuity
- super pinhole visual acuity test
- 10-2 central visual field analysis
- Amsler chart
- Pelli-Robson contrast sensitivity
- Frequency doubling perimetry
- Fast central visual field analysis -test binoculare di Esterman
- Confrontation field testing
- Farnsworth-Munsell D-15
- City University test
- the Ishihara colour vision test

3. Determination of the refractive correction

- Relevant case history information
 - Relevant visual acuity information
 - Keratometry
 - anatomical pupillary distance
 - Phoropter and trial frame forottero
 - static retinoscopy
 - autorefraction
 - monocular subjective refraction
 - Maximum plus to maximum visual acuity (MPMVA)
 - the plus/minus technique for best vision sphere determination
 - Duochrome (or biochrome)test
 - the Jackson cross-cylinder
 - fan block test
 - Prism-dissociated blur balance of accommodation
 - Humphriss test
 - binocular subjective refraction
 - tentative reading addition using calculation
 - tentative reading addition using assessment of accommodation
 - trial frame determination of a reading addition and range of clear vision
 - prescribing rules
- ### 4. Assessment of binocular vision
- relevant case history information
 - relevant information from assessment of other system
 - classification of heterophoria
 - classification of comitant heterotropia
 - Cover test
 - Hirschberg, Krimsky and Brookner

- Modified Thorington test
- Maddox rod
- Maddox wing
- Von Graefe phria technique
- Modified gradient AC/A test
- Fusional reserves (fusional vergences)
- the Mallett fixation disparity unit
- Prismatic flipper
- Near point of convergence
- Jump convergence
- push up/push down amplitude of accomodation
- Nott and MEM dynamic retinoscopy
- accomodative flipper
- Worth 4-dot test
- 4dtp BO test
- titmus fly test
- classification of incomitant heterotropia
- the motility test
- Pursuit (as part of motilità testing)
- 9 point Cover test
- Park's 3-step test
- Saccades

5.Principles of ocular heath assessment

- relevant case history information
- relevant visual function information
- relevant binocular vision information
- variation in appearance of the normal eye in young adult
- vriation in appearance of the normal elderly eye
- slit lamp examination
- pupil light reflexes and swinging flashlight test
- Direct ophtalmoscopyo
- Indirect ophtalmoscopy (principles)
- digital imaging

supplement topics:

OEP 21 points

Graphical analysis

Textbooks:

I modulus

- Faini M. : Lezioni di optometria I, 2003
- Faini M. La schiascopia. In: Metodi di rifrazione, ISSO Milano, 1999.
- Henson D. Optometric Instrumentation. Butterworths, 1996, London.
- Paliaga G.P.: I vizi di refrazione, Torino, Minerva Medica,.
- Paliaga G.P. L'esame del visus. Edizioni Minerva Medica, 1991, Torino.
- Scheiman M., Wick B. Clinical management of binocular vision. J.B. Lippincott Company, 2002, Philadelphia.
- Articoli vari e fotocopie fornite dal docente

II modulus

Clinical Procedure in Primary Care D.B. Elliott Butterwoth Heinemann 2007

Clinal Optics and Refraction A. Keirl; C Christie Butterwoth Heinemann 2007

Readings:

-Primary care optometry Grosvenor T, Butterwoth Heinemann 2002

-Clinical Pearls in refractive care L. Werner, L. Press Butterwoth Heinemann 2002

LABORATORY OF PHYSICAL TECHNIQUES FOR THE GENERAL OPTOMETRY – 8 cfu

Lecturer:

Course description:

The laboratory course is aimed at teaching the correct use of the instruments of a modern optometry clinic and at the practice of those tests discussed in the course of *Physical Techniques for the General Optometry*.

Examination: practical and oral exam

OPTICS OF THE CONTACT LENSES – 12 CFU

I modulus – 6 cfu

II modulus – 6 cfu

Lecturers:

I modulus: Prof. Silvio Maffioletti (a.a. 2007/2008)

silvio.maffioletti@unimib.it

II modulus: Prof. Sandro Bresciani (a.a. 2007/2008)

sandro.bresciani@fastwebnet.it

Description of the course

I modulus

Introduction to contact lenses

Selection of the wearers

Test for the new wearers of contact lenses

Measurements of the anterior segment of the eye

Test of preapplication

Hard contact lenses

Wear of the hard contact lenses: instructions and contraindications

Methodologies of application of the hard contact lenses

Maintenance of the hard contact lenses

Alterations caused by the hard contact lenses

II modulus

Test for the new wearers of contact lenses, examination and measurement of the anterior segment of the eye

- Choice of the contact lenses among the available ones for type and material

- Basic theory and systems of application: lenses design, order specifications, verification of the lenses and valuation, wearing and remove, plan of wearing of the lenses, biomicroscopical test and principles of application

- Maintenance of the lenses: handling, cleaning ,available preservatives, methods of disinfection and solutions

- Successive examinations: physiological complications and complications of the later applications, allergical reactions, change of the lenses, mechanical problems

- Bifocal and astigmatic contact lenses: basic types for selection, techniques of application

- Lenses with inverse geometry, special design, corneal irregularity, sport vision, corneas with traumas and diseases, cosmetic and prosthetic lenses, changes of the iris colour and anomalies in the colour sight

Legislation relative to the registration and the supply of:

- Contact lenses
- Disinfection systems for contact lenses

Textbooks:

I modulus

Obligatory bibliography

- 1 Lupelli L., Fletcher R., Rossi A.L. *Contattologia-Una guida clinica*. Palermo, Medical Books, 2004
- 2 Bennet E., Weissman B. *Clinical Contact Lens Pratic*, Lippincot Williams & Wilkins, 2005
- 3 Efron N. *Contact Lens Complications*. Butterworth-Heinemann, 2004
- 4 Bennet E., Hom Milton M., *Manual of Gas Permeable*, Butterwhorth, 2001

Advised bibliography

- 5 Milton M. Hom. *Manual of Contact Lens prescribing and fitting with CD Rom*. Butterworth-Heinemann, 2000
- 6 Ponthwhite W.A., *Contact Lens Optics and Lens design*, Elsevier, 2006

II modulus

Obligatory bibliography

- 1 Bennet E., Weissman B. *Clinical Contact Lens Pratic*, Lippincot Williams & Wilkins, 2005
- 2 Bennet E., Hom Milton M., *Manual of Gas Permeable*, Butterwhorth, 2001
- 3 Lupelli L., Fletcher R., Rossi A.L. *Contattologia-Una guida clinica*. Palermo, Medical Books, 2004
- 4 Articoli e appunti forniti dal docente

Advised bibliography

- 5 Milton M. Hom. *Manual of Contact Lens prescribing and fitting with CD Rom*. Butterworth-Heinemann, 2000
- 6 Ponthwhite W.A., *Contact Lens Optics and Lens design*, Elsevier, 2006
- 7 Efron N. *Contact Lens Complications*. Butterworth-Heinemann, 2004
- 8 Cappa S., *Conspicilla, storia comparata di sette secoli della professione oftalmica*, Edizione La Lontra Genova, 2004

Examination: written and oral exam

LABORATORY OF OPTICS OF THE CONTACT LENSES - 8 cfu

Lecturer:

Description of the course:

Soft Contact Lenses

- 1 Clinical Ex.: Soft contact lenses advantages and contraindications.
- 2 Clinical Ex.: Evaluation of the anterior segment of the Eye by means of slit lamp.
- 3 Clinical Ex.: Identification and marking of any abnormal or pathologic condition by means of CCLRU and Efron's grading scales.
- 4 Clinical Ex.: Initial evaluation and soft contact lens selection
- 5 Clinical Ex.: Selection and application of a spherical soft contact lens.

- 6 Clinical Ex.: Inspection and verification of movement, centration and visual performance of the spherical soft contact lens. Problem solving.
- 7 Clinical Ex.: Dispensing of soft toric contact lenses. Lens selection regarding the amount of astigmatism, lid configuration and anatomy, lens design and stabilizing techniques.
- 8 Clinical Ex.: Soft toric contact lens fitting
- 9 Clinical Ex.: Inspection and verification of movement, centration, rotation and visual performance of the spherical soft contact lens. Problem solving.
- 10 Clinical Ex.: Keratoconus contact lens fitting. Keratoconus evaluation and classification. Lens and fitting techniques selection on the basis of severity of keratoconus.
- 11 Clinical Ex.: Hybrid materials and design. Softperm and piggyback design fitting.
- 12 Clinical Ex.: Presbyopic correction with soft and rgp contact lenses. Lens design evaluation and lens selection. (monovision, simultaneous vision and translating vision).
- 13 Clinical Ex.: Contact lens applications for ocular trauma and disease. Therapeutic contact lenses.
- 14 Clinical Ex.: Contact lens applications in post-refractive and post-penetrating keratoplasty surgery patients.
- 15 Clinical Ex.: Corneal reshaping and reverse-geometry design lenses fitting. Basic principle concerning overnight contact lens wear.
- 16 Clinical Ex.: Disposable contact lenses fitting. Material selection. Basic principle concerning dry eye treatment.
- 17 Clinical Ex.: Soft contact lens care regimens and patient education. Artificial tear drops and lubricants.

III ANNO (61 cfu)

PHYSICS III WITH LABORATORY - 8 cfu

Lecturer: Prof. Anna Vedda

anna.vedda@unimib.it

Description of the course:

- 1) Elettromagnetic waves: plane and spherical waves, energy and momentum, irradiance, radiation pressure.
- 2) Interference of waves: condition for interference, interference from two slits (Young experiment)
- 3) Diffraction: Fraunhofer diffraction ,diffraction grating, angular dispersion and linear reciprocal dispersion, resolution and Rayleigh criterium, resolving power.
- 4) Polarization :linear, circular, elliptical polarization, polarizers and Malus's law, birefringence, scattering and polarization.
- 5) Light and quantum physics: blackbody radiation, law of Stefan-Boltzman, Wien's law ,blackbody spectrum , Rayleigh-Jeans and Planck formulae, energy quantization and photoelectric effect, Compton effect, line spectra , Balmer and Rydberg formulae for the hydrogen spectrum.
- 6) The Bohr model of the atom: stationary states, energy and angular momentum quantization, electronic transitions , photon emission and absorption, Pauli exclusion principle ,quantum numbers, the periodic table of elements.
- 7) Matter waves: diffraction and interference of particles, De Broglie wavelength, energy and momentum of photons and waves.
- 8) Conduction in solids: metals, semiconductors and insulators, bands in crystals, conduction band and valence bands, Fermi-Dirac probability function, doped semiconductors , p-n junction and its properties

Textbook: Gettys, Keller, Skove, "Fisica classica e moderna" vol. 2 (Elettromagnetismo e fisica moderna)

Examination: oral exam

PHYSICAL TECHNIQUES FOR ADVANCED OPTOMETRY WITH LABORATORY – 8 cfu

Lecturer: Prof. Mauro Faini (a.a. 2007/2008)

mauro.faini@unimib.it

Description of the course:

The course is aimed at teaching how to analyse the whole optometric data. It concerns the analysis of the preliminary exams and the phorometric data, to be compared with the case history; a comparison among all the tests learned in the course of *Physical techniques for the General Optometry*, with addition of the prescription rules of classical criterion of physiological optic.

The graphical analysis method will be used, because it is didactically more effective to point out and consider the various visual abilities, adding a series of extraneous considerations to traditional graphical analysis and deriving from other analysis methods of behavioral Optometry.

The students analyse in turn, and with the participation of all students, real patients with prescription and comment of all tests with some considerations of the result of stress reaction of visual system.

It considers the various possibilities of deterioration of visual and perceptual systems, from

the classical Duane's syndromes to the more actual of behavioural Optometry, which are the bases of a training activity, not only visual but of more wide perceptual system.

LABORATORY

Execution of complete exams, before among course students and after with other courses students, analysis of the data and comments of the students, with the correction of the teachers.

Textbooks:

- Faini M.: L'analisi visiva col metodo grafico, Franco Angeli, Milano Bookshop Biccoca, 1992
- Materiale consegnato dal docente.

Advised readings:

- Birnbaum M.: Optometric Management of Nearpoint Vision disorders Butterworth Heinemann;
- Scheiman M., Wick B.: Clinical Management of binocular vision Lippincott Williams & Wilkins:

Examination: written and oral exam

PHYSICS OF VISION – 4 cfu

Lecturer: Prof. Riccardo Tubino

riccardo.tubino@mater.unimib.it

Description of the course:

- The nature of light. Maxwell equations and electromagnetic waves. The electromagnetic spectrum and the visible spectrum Photons. Blackbody radiation.. Planck equation. Absorption and emission of radiation. Einstein coefficients. Transition moment and oscillator strength. Solar emission spectrum. Color by incandescence and light bulbs.
- Colors of the materials and of the nature. Opaque and transparent materials..Band structure of the solids:color of metals and insulators. Color due to refraction and dispersion. Color due polarization and dispersion. Color due to reflection. Interference in a thin film. Variation of the interference with the viewing angle. Color of a thin film on a substrate. Color due to scattering. Rayleigh and Raman scattering. Mie scattering. Color of the sky.
- Color from atoms and ions. Electronic configuration of atoms. Quantum numbers. Atomic spectra. Selection rules. Fraunhofer lines. Neon and street lighting.
- Color from molecules. Pigments. Molecular electronic states. Confined free electron model. Molecular orbitals. Conjugated systems. Molecular electronic transitions. Chromophores. Radiative and non radiative decay. Kasha rule. Lifetimes. Fluorescence and phosphorescence.
- Color vision. Why we see. Additive and subtractive mixing. Color atlas. Tristimulus and chromatic coordinates. CIE diagram. Dominant wavelength and color purity.. Color temperature. Photometric units.
- Photophysics of vision. Carotenoids. Rhodopsin. Configurational diagrams for the excited states. Photoisomerization process. The rhodopsin photophysical cycle. Visual stimulus transduction.
- Color-related technologies. Fibers and data transmission. Optical amplification. Displays. Electroluminescent devices: LEDs and OLEDs. Liquid crystals. Plasma displays. Antireflective coating. Dielectric mirrors. Photonic engineering

Suggested texts

K.Nassau, *The physics and chemistry of colors*, Wiley, 2001
A. Frova, *Luce, colore, visione*, BUR,2003
D.S Falk, D.R. Brill, D.G Stork *Seeing the light*, Wiley, 1986
Online course: <http://hyperphysics.phy-astr.gsu.edu/Hbase/ligcon.html>

OPTICAL PROPERTIES OF MATERIALS – 4 cfu

Lecturer: Dott.ssa Silvia Tavazzi

silvia.tavazzi@unimib.it

Description of the course:

1. DUALITY WAVE/PARTICLE: AN INTRODUCTION
2. THE MATHEMATICS OF WAVE MOTION
Harmonic waves;
Real and complex representation of wave motion;
Phase and phase velocity;
Scalar and vectorial waves;
Polarized plane waves.
3. ELECTROMAGNETIC WAVES
Maxwell's equations for static electric and magnetic fields in vacuum and in dielectric media: definition of the dielectric constant of dielectric media;
Maxwell's equations for variable electric and magnetic fields in vacuum and in dielectric media: definition of the dielectric function of dielectric media;
Wave equation: propagation of electromagnetic waves;
Complex refractive index and complex dielectric function;
Dispersion of the electromagnetic waves in the materials;
Attenuation of the electromagnetic waves in the materials.
4. TRANSMISSION AND REFLECTION
Transmission of the electromagnetic waves in the materials, definition of the absorption coefficients, and Lambert-Beer law, optical density;
Reflectivity of an interface at normal incidence, multireflections
Transmittance, absorbance, and reflectance spectra at normal incidence
Transmittance spectra of colored filters and pigments: colorimetry
Colorimetry: an introduction.
4. FRESNEL'S EQUATIONS
Refraction and reflection of linear polarized light at oblique incidence (p and s polarizations);
Transmittivity and reflectivity at non-normal incidence;
Brewster's law and polarization of the reflected light;
Interference of reflected light from thin layers or films and Newton's rings.
5. OPTICAL ANISOTROPY
Definition of the Bravais lattice and classification of the crystallographic structure of crystals;
Dielectric tensor of the uniaxial and biaxial anisotropic media;
Transverse / longitudinal propagation of light in anisotropic media;
Birefringence and birefringent polarizers, prism of Nicol;
Dephasing layers;
Dichroic polarizers.
6. EXPERIMENTAL TECHNIQUES
Lamps, monochromators, detectors;

Spectrophotometer;

Experimental configurations for transmittance, reflectance, and ellipsometry measurements.

7. MICROSCOPIC THEORY

Bravais and reciprocal lattices of crystals;
Energy bands of solids and dispersion curves;
Insulators, semiconductors and metals;
Colours of natural crystals;
Lorentz and Drude models;
Non linear optics: an introduction.

8. EMISSION PROPERTIES OF MATERIALS

Fluorescence and phosphorescence;
Emission of atoms, molecules, solids

Textbooks:

- a. E. Hecht, *Optics*, Addison-Wesley Publishing Company, 1987
- b. F.W. Sears, *Ottica*, Ed. CEA
- c. G. Burns, *Solid State Physics*, Academic Press
- d. Notes course supplied by the Lecturer.

Examination: oral exam

PRINCIPLES OF OCULAR PATHOLOGY – 4 cfu

Lecturer: Prof. Stefano Miglior

stefano.miglior@unimib.it

Description of the course:

1. Epidemiology, anamnesis, list of symptoms
2. Observation, inspection, recognition of symptoms and techniques
3. physiopathology, diagnosis, prognosis
4. signs of ocular pharmacology
5. toxicology

The points 1, 2 and 3 will be treated for:

ocular adnexa

Tear system

conjunctiva

cornea

Sclera, episclera

Inner uveal (irises and ciliary bodies)

pupilar pathology, accommodative and refractive

Eye sockets

Outer chamber, structure of angle and IOP anomalies

Lens/phacoma/pseudophacos

Rear pole

Periphery of the eye

Optical nerve

Neuro-sensory visual pathology

Oculomotor neuropathology

Examination: oral examination

COURSES CHOSEN BY THE STUDENT - 12 cfu

Suggestions

Ophthalmic Materials - 4 cfu.

Visual Optics - 4 cfu

OPHTHALMIC MATERIALS - 4 cfu

Lecturer: Vincenzo Malatesta (a.a. 2007/2008)

Description of the course

Course scope: (2 lines)

An overview of the materials used in the correction of ametropia with particular attention paid to the chemical and physical properties that affect vision.

Main topics:

The vitreous state: crystallization and glass-forming substances, compositional diagrams. Composition and chemical properties of optical glass. Manufacturing methods of high refractive index glass. Introduction to polymerisation. Synthesis and characteristics of more common hard resins: CR39, polycarbonate, PMMA, polyurethanes, hydrogels. Contact lens (CL) production. Classification, nomenclature, and composition of materials used in contact lens industry. Chemical and physical properties of contact lenses: transparency, n, refractive index, stability, hydration, wettability, oxygen permeability. Optical filters. Frames materials. Contact lens solutions. Ionic balance in CL solution. Disinfection and sterilization. Antiseptics, tensides, surfactants, and enzymes used in C.L solution. Deposits and their prevention. Overview of the characteristics of various CL solutions specifically designed for rigid, rigid gas permeable (RGP), and soft contact lenses.

Textbook:

Mario Casini "Sistemi chimici di disinfezione in Contattologia" Ed. Optoforum

Notes given by the lecturer

Examination: oral exam

VISUAL OPTICS – 4 cfu

Lecturer: Prof. Renato Pocaterra (a.a. 2007/200) renato.pocaterra@unimib.it

Description of the course:

1. Visual perception.

Psychofisic chain.

Psychological approach.

Principal theories on the perception.

Selective attention: Bottom-Up process.

The system of opinions: top-Down process.

Psychology of the attention.

Look: the ocular movements

2. Nature of the ocular movements.

Eye-motor system.

Fixation fields.

Eyes movements.

Extra ocular muscles.

Glance positions.

Fundamental laws.

Ductions.
Versions.
Vergence.
Convergence.
3. Binocular vision.
Retinical correspondence.
Diplopia.
Sensory fusion.
Retinical rivalry.
Oroptero.
Physiological diplopia.
Fusion Panum area.
Physiological bases of the Stereopsi.
Monocular clues.
Binocular clues.
Deep pringes.
4. Development Visuo-motor.
The motor and perceptive development in the fetus.
The motor and perceptive development in the newborn baby.
The sleep and wake states the ocular movements in the newborn baby.
The anatomic and functional development of the visual receptor in the newborn baby.
The attentive condition in the newborn baby.
The intermodal perception in the newborn baby.
5. The perception of the colours.
The nature of the light.
Additive synthesis.
Subtractive synthesis.
Tricromatic theory.
Theory of the opposition processes.
Anomalies in the vision of the colours.

Textbooks:

COMPULSORY BIBLIOGRAPHY

MASSIRONI M., *Fenomenologia della percezione visiva*, Bologna, il Mulino, 1998
WADE N.J., SWANSTON M. T., *Visual Perception*, Brighton U.K., Psychology Press, 2001
AIRAGHI E., ALTIMANI A., *I muscoli dell'occhio e la funzionalità binoculare*, Milano, Acofis, 1997
RUGGERI L., MAFFIOLETTI S., POCATERRA R., "Lo sviluppo della visione", notes of Visual Optic

RECOMMENDED BIBLIOGRAPHY

HUBEL D.H., *Occhio, cervello e visione*, Bologna, Zanichelli, 1998

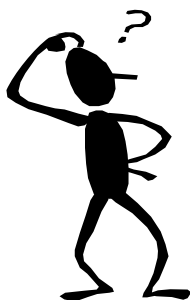
Examination: written and oral

OTHER SUGGESTED COURSES:

Pharmaceutics (Biological and Biotechnology Sciences) - 4 cfu

Visual Perception (Physiology) - 8 cfu

PRACTICAL GUIDE FOR STUDENTS OF THE DEGREE IN OPTICS AND OPTOMETRY



INTRODUCTION

This short Guide gives some information and useful suggestions to the students of the Degree aimed at orienting themselves at the beginning of their university experience so that they can take an active part in their own training, in their interaction with the university institutes. Indeed, in some cases, it happens that students do not know either the teaching or research structures related to their Degree or the names of people who can help them when necessary.

This Guide is divided in different sections and provides information on:

University staff;

Degree or Didactic Coordination Council;

Department of Materials Science;

Main facilities;

Post-graduate courses.

IMPORTANT NOTE

This edition of the Guide is the first attempt to cover this Degree course; therefore, we welcome any comments and suggestions to improve it over the coming years.

THE STAFF AT THE UNIVERSITY

Teaching staff

There are three levels for the personnel of the university involved in teaching activities: full professors, associated professors, and researchers. Each professor has one or two courses whose contents and organisation are agreed with other colleagues, under the supervision of the Degree Council (CCL, see below). Researchers support the teaching activities by Faculty appointment under auspices of the CCL. They usually support teachers with practical exercises or, in some cases, they can substitute the regular professor; they also take part in the examination committee. When a regular professor is lacking for a particular course, researchers with the most experience in the field can be allocated by the Faculty as a regular teacher of that course.

The direct contact with teachers is of fundamental importance. Almost all of them are at the Department of Materials Science (see below) and they devote time to the students for explanations, suggestions, and orientation activities in general. This is a fundamental aspect of the training at the University

Non-teaching staff.

It is divided into technical and administrative personnel. The former includes engineers of different levels (they can have either a diploma or a degree); they support the teaching and research activities,

with different tasks according to the different professional positions. Usually students meet the engineers in the laboratories. The administrative personnel include all the employees of the departments, the institutes or the other institutions of the University. Usually students meet the employees of the student secretaries.

THE DEGREE COUNCIL

The Didactic Coordination Council (CCD) is responsible for the teaching activities of the Degree. It includes all the teachers of the relative Courses, three representatives of the researchers with teaching appointments, and two student representatives. The Council organizes the teaching activities and co-ordinates the contents of the different Courses, distributing the teaching appointments, deciding which courses to hold, etc.

It is very important being in contact with the student representatives, who are present during CCD meetings and up to date with all course developments. It is important that these representatives are chosen by the students, and elections usually take place every two years.

A full professor is the President of the CCD, as chosen by the members of the CCL and maintains this role for three years. The CCD co-ordinator is responsible for organizing and programming the teaching activities and has some time to receive students for advice and discussion of any problems regarding the courses and their course direction. At present, Prof. Nice Terzi is the President of CCD and Prof Antonio Papagni the Degree Supervisor.

A constant contact with the Co-ordinator or Supervisor is very important, via the student representatives and, when necessary, also directly. An important reference paper is the teaching code of the University of Milan, Bicocca, which deals with all the subjects on the teaching, such as the programming activities, the student career, plans for their studies, etc. The appendix is particularly relevant, where the tutoring activities are illustrated, and shows the support offered by the University throughout the degree. For the present Degree, course tutors are presently being organised.

It is very important that the student representatives knows the teaching code, in particular as far as the tutoring opportunities are concerned there is a teaching Secretary for the Degree, who is at the Department of Materials Science, first floor. (see below). Alessandra Danese is responsible for this and her address is:

Dipartimento di Scienza dei Materiali
via Roberto Cozzi, 53 - 20125 Milano
tel: 02 6448 5102
fax: 02 6448 5400

There is also a web page on the Degree, which is :

<http://www.mater.unimib.it/didattica.htm>

Other information about the University can be found at:

<http://www.unimib.it>

THE MATERIALS SCIENCE DEPARTMENT

Each Degree is related to one or more institutions of the University, Departments or Institutes, which consist of administrative and research structures. For this degree, the Materials Science Department collects people who are working for the University of Milano Bicocca, in the relevant field of the research and teaching. The Department is located at via Roberto Cozzi 53 (U5 building of the Bicocca campus). Here, one can find all the teaching and research laboratories and offices of the professors, and both the teaching and administrative secretaries, together with places where students can study.

The Director of the Department is Prof. Gianfranco Pacchioni and there is a Council which includes all the teachers and researchers of the Department, independently of the particular Degree. Moreover, this Council includes the administrative secretary of the Department, three representatives of the non-

teaching staff, and two representatives of the students of the Ph.D. Course. A few members of the Department Council form a committee, which works in connection with the Director.

Teachers and researchers work in different fields of research, which is a fundamental part of the activity of the University, together with the teaching activities. . Students work on their theses for the Degree in the Department. In this respect, it is also possible to work for the thesis in an outside company, within the conventions of the University and under supervision of a teacher of the Faculty. The Department is responsible for the organisation of teaching activities, such as lecture halls, laboratories, etc. (see below).

The contact the student makes with the Department Secretary is very important, in particular in the case of problems with any of these services.

THE MAIN SERVICES

The Course employs a lecture hall for each year of the course; this is decided at the beginning of the academic year. Some halls are in the Department (third floor), Also a few laboratories are in the same building (ground floor). They are well organised and spacious, this latter aspect being very important for this degree, where the experimental activity is considered fundamental.

A few rooms are available for students who want to study at the University, together with other colleagues. A large area is also open to all the students of the campus (U3), while for the students in Optics and Optometry there is also an area in the U5 building (third floor).

Notice boards are efficient media for communicating in the University. Two boards are in our Department (ground and first floor). The former is devoted to notices on courses, examinations, teaching activities; the latter is devoted to scientific seminars or notes on after-degree courses (see below). A further board (second floor) is devoted to research activities, summer schools, meetings etc.

Books and scientific journals are located in the library of the Department. Students can use it only during the period of their thesis preparation for the Degree.

A few terminals (SIFA) have been installed. They offer various services for the students, such as admissions, exam entries, and information on their career. Terminals are located in the different buildings (U1, U2, U3, U4, U5, U6, U7, Monza Via Cadore 48).

A few ISU services are available: book loan, fellowships, university residences, and refectory.