Bachelor in Optics and Optometry University of Milano-Bicocca

Code E3002Q	Bachelor in Optics and Optometry University of Milano-Bicocca	year	semester	Ects
E3002Q001	Mathematics I	1	1	8
E3002Q027	Chemistry.	1	1,2	12
E3002Q030M	Inorganic Chemistry module		1	6
E3002Q031M	Organic Chemistry module		2	6
E3002Q032	Human and Ocular Anatomy and Histology;	1	1	8
E3002Q033	Geometric and Ophthalmic Optics with Laboratory	1	1	8
E3002Q006	Physics I	1	2	8
E3002Q008	General and Ocular Physiology	1	2	8
E3002Q009M	General Physiology			4
E3002Q010M	Ocular Physiology			4
E3002Q028	Optical and Ophthalmic Systems with laboratory	1	2	6
	European Language	1	1,2	3
LFRA	French			3
LING	English			3
LSPA	Spanish			3
LTED	German			3
E3002Q018	Principles of Ocular Pathology (not provide the academic year 2016-2017)	3	1	4
E3002Q010	General Physical Techniques for Optometry	2	1,2	12
E3002Q024M	General Physical Techniques for Optometry 1		1	6
E3002Q028M	General Physical Techniques for Optometry 2		2	6
E3002Q012	Laboratory of Physical Techniques for Optometry	2	1,2	8
E3002Q009	Physics II	2	2	8
E3002Q011	General optics of contact lens fitting	2	1,2	12
E3002Q020M	General optics of contact lens fitting 1		1	6
E3002Q027M	General optics of contact lens fitting 2		2	6
E3002Q037	Laboratory of Physical Techniques for Contact lens Fitting	2	1,2	8
E3002Q002	Mathematics II	2	1,2	8
E3002Q039	History of modern physics and optical instruments active from 2017-2018	3	1	6
E3002Q034	Advanced Optometry.	3	1	8
E3002Q029	Interaction matter with light	3	1	6
E3002Q040	Visual Perception (not provided the academic year 2016-2017)	2	1	6
E3002Q031	Physic III with lab active only academic 2016-2017	3	1	6
E3002Q030	Optical instruments and their historical evolution active only academic 2016-2017	3	1	6
E3002Q035	other formative activities (participation to seminar and others)	3	2	5
E3002Q036	Bachelor Thesis or Internship	3	2	13
E3002Q022	Final examination	3	2	3
	Elective courses	3	2	12
	Total ECTS			180

Note the course of Physic III with Laboratory and Optical instruments and their historical evolution are active till the Academic Year 2016-2017; from the academic year 2017-2018 these courses are replaced by History of modern physics and optical instruments

Erasmus students interested in spending their mobility at Milano-Bicocca University

6 months of stay:
II semester of III year;
To fill the Learning Agreement with:

E3002Q035	**other formative activities (participation to seminar and others)**	**3**	**2**	**5**
E3002Q036	**Bachelor Thesis or Internship**	**3**	**2**	**13**
	Elective courses	**3**	**2**	**12**
	Total ECTS			**30**

Suggested elective courses:

E3002Q039	**History of modern physics and optical instruments active from 2017-2018**	**3**	**1**	**6**
E3002Q034	**Advanced Optometry.**	**3**	**1**	**8**
E3002Q029	**Interaction matter with light**	**3**	**1**	**6**
E3002Q040	**Visual Perception (not provided during 2016-2017 academic year)**	**2**	**1**	**6**

12 months of stay:
For the II year of our program, to select courses within this list:

E3002Q018	**Principles of Ocular Pathology (not provide on the academic year 2016-2017)**	**3**	**1**	**4**
E3002Q010	**General Physical Techniques for Optometry**	**2**	**1,2**	**12**
E3002Q024M	**General Physical Techniques for Optometry 1**		**1**	**6**
E3002Q028M	**General Physical Techniques for Optometry 2**		**2**	**6**
E3002Q012	**Laboratory of Physical Techniques for Optometry**	**2**	**1,2**	**8**
E3002Q011	**General optics of contact lens fitting**	**2**	**1,2**	**12**
E3002Q020M	**General optics of contact lens fitting 1**		**1**	**6**
E3002Q027M	**General optics of contact lens fitting 2**		**2**	**6**
E3002Q037	**Laboratory of Physical Techniques for Contact lens Fitting**	**2**	**1,2**	**8**
E3002Q039	**History of modern physics and optical instruments active from 2017-2018**	**3**	**1**	**6**
E3002Q040	**Visual Perception (not provide on the academic year 2016-2017)**	**2**	**1**	**6**

12 months of stay:
For the III year of our program, we suggest to select courses within the following list:

E3002Q039	**History of modern physics and optical instruments active from 2017-2018**	**3**	**1**	**6**
E3002Q034	**Advanced Optometry.**	**3**	**1**	**8**
E3002Q029	**Interaction matter with light**	**3**	**1**	**6**
E3002Q040	**Visual Perception (not provide on the academic year 2016-2017)**	**2**	**1**	**6**

E3002Q035	**other formative activities (participation to seminar and others)**	**3**	**2**	**5**
E3002Q036	**Bachelor Thesis or Internship**	**3**	**2**	**13**
	Elective courses	**3**	**2**	**12**
E3002Q027	**Chemistry.**	**1**	**1,2**	**12**
E3002Q030M	**Inorganic Chemistry module (as elective module)**		**1**	**6**
E3002Q031M	**Organic Chemistry module (as elective module)**		**2**	**6**
	European Language (basic level B1)	**1**	**1,2**	**3**
LFRA	**French**			**3**
LING	**English**			**3**
LSPA	**Spanish**			**3**
LTED	**German**			**3**

Students can select courses of Advance European Language provided by our University.

Mathematics I

- Lecturer: Luigi Fontana
- Course Mathematics I
- I year; I semester
- Examination: written and oral; evaluation: mark
- Didactic activity: lectures 5 ECTS (8h/ECTS), exercitations 3 ECTS (12h/ECTS)
- AIMS
  - To provide the bases of calculus
- PREREQUISITES
- None
- PROGRAM DETAILS
  - 1. Function and models: lines, polynomials, rational functions, roots, Exponential and logarithmic functions. 2. Limits and derivatives: the tangent and velocity problems, limit of a function, rates of changes. The derivative of a function. 3. Differentiation rules: the product and quotients rules; the chain rule. Implicit differentiation. application of differentiation: related rates, maximum and minimum values. Optimization problems. The shape of a curve. 4. Integrals: areas and distances. The Definite integral. The fundamental Theorem of Calculus. Techniques of Integration. Application of Integration: Areas, volumes, arc length. 5. Infinite series and sequences: limit of a sequence. Convergence of a series: convergence tests.

Chemistry

- Lecturers : Franca Morazzoni, Antonio Papagni
- Course: Chemistry
- I year; I and II semester
- Didactic activity:. 12 ECTS lectures (8h /ECTS)
- Examination: written and oral; evaluation: mark
- AIMS
  - The basic concepts in inorganic and organic chemistry will be provided to the student together with basic concepts on chemical equilibrium, on molecular geometry and on the nature and reactivity of the mean functional groups
- PREREQUISITES

  none
- PROGRAM DETAILS

I Modulus: Inorganic chemistry ï 6 cfu
I semester

A) Matter: atoms and molecules. Stoicheiometry: 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 Chatelierôs 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: Organic Chemistry - 6 cfu
II semester

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 rappresentations.
Isomery: structural, configurational, conformational and stereoisomery, concept of stereogenic element.
Chirality: optical purity and activity, diastereo and enanthiomorphism; 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
Short introduction to chemistry of the vision. Polymeric glasses and contact lenses: properties and preparations

Suggested reading:
Inorganic chemistry module:
W. L. Masterton, C. N. Hurley, *Chimica: principi e reazioni* (Piccin, 2007). Oppure:
M. S. Silberberg, *Chimica: la natura molecolare della materia e delle sue trasformazioni* (Mc Graw Hill, 2008).
Organic Chemistry module:
W. Brown, T. Poon, *Introduzione alla chimica organica* (IV edizione Edises)
Notes provides by the lecturer

Human and Ocular Anatomy and Histology

- Course: Human and Ocular Anatomy and Histology;
- I year; I semester
- Examination: written and oral; evaluation: mark
- Didactic activities: lectures 8 ECTS (8h/ECTS)
- AIMS
  - The course provides an overview on morpho-functional aspects of the different apparatuses of the human body The course provides the basic knowledge of the visual system structure in relationship with related skeletal, muscular, vascular and nervous structures.
  - To provide an understanding of the microscopic and submicroscopic structure of the human cells and tissues, their interactions and functional implications

  PREREQUISITES
  - none
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- PROGRAM DETAILS
  - Methods for studying cells and tissues.
  - General considerations of the cell: cell form, cell size, cell life and 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.
  - 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.
  - The structure of the skull. The facial muscles, with particular reference to the extraocular muscles of the orbit 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. 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. Terminology and anatomical co-ordinates. Classification of organs and their structural schemes.
  - General organization of human body apparatuses, some of them are analyzed in details.
  - The common integument: the skin and glands. The locomotion apparatus: bones, muscles and joints. The vertebral column and the skull. The respiratory apparatus: the lungs. The cardiovascular apparatus: the heart, vessels, the lymphatic system and bone marrow. The endocrine apparatus: the hypophysis cerebri, the thyroid gland, the suprarenal glands and Langerhans islets.
  - The nervous apparatus: histology of nervous tissue. General organization of of central and peripheral nervous systems and of organs of senses.

General and Ocular Physiology

- Lecturer: Marzia Lecchi,
- Course: General and Ocular Physiology
- I year; II semester
- Examination: written and oral; evaluation: mark
- Didactic activities: lectures 8 ECTS (8h/ECTS)
- AIMS

  The course addresses the principles of general physiology and describes the main aspects of ocular physiology.
- PREREQUISITES: Anatomy and Histology, Organic Chemistry
- PROGRAM DETAILS
  - Cell biochemistry. Diffusion. Passive and active membrane transport. Fundamentals of neurophysiology. Reflex arcs and neuromuscular control. Hormones. Introduction to epithelial physiology. Respiratory and circulatory physiology. Sensory mechanisms, photoreceptors, retina, cerebral processing of visual information. Main properties of the parts of the human eye. Nutrition, protection and motility.

Geometric and Ophthalmic Optics with Laboratory

- Lecturer Silvia Tavazzi
- Course: Geometric and Ophthalmic Optics with Laboratory
- I year; I semester
- Examination: written and oral; evaluation: mark
- Didactic activity: lectures 5 ECTS (8h/ECTS), laboratory activities 3 ECTS (12h/ECTS)
- AIMS
  - Provide the student with basic geometric optics , the ability of planning a simple optic system, fundaments on eye as optic system. In the laboratory the student will practise with lenses, mirrors and with the fundamental laws of geometric optics
- PREREQUISITES: Mathematics (basic algebra, trigonometry, calculus)
- PROGRAM DETAILS
  - Introduction: light and Fundamentals of geometrical optics; Newton's particle model; Huygens' wave model; Fermat's principle; photometry; visibility curve; Mechanical equivalent of light; brightness and Lambert's law; optics of spherical surfaces; paraxial approximation; magnification; Lagrange-Helmholtz's theorem; resolution of an optical system; magnification of an optical instrument; Magnifying glass; thick lenses and systems of lenses; Gullstrand's formula; power of a thick lens; lens combination; telescopes; the human eye as an optical system; geometrical aberrations; spherical aberrations; position and shape Coddington's factors; Correction of spherical aberrations with a doublet; astigmatism; cylindrical lenses; aspheric surfaces; Dispersion of light and chromatic aberrations. Laboratory sessions on: reflection of light: plane and spheric mirrors, object/image relationship; refraction of light: refractive index, Snellôs law, internal total reflection, refraction at plane and parallel interfaces, prism, prismatic deviation, chromatic dispersion, optical lenses and object-image relationship, law of conjugated points, image constructions, aberrations. eye, defects and corrections; photometry: flux, intensity, and luminance; lensometer; theory of errors.

▪ Physics I

- Lecturer: Adele Sassella
- Course Physics I
- 1 year; 2 semester
- Examination: written and oral; evaluation: mark
- Didactic activity: lectures 6 ECTS (8h/ECTS), exercitations 2 ECTS (12h/ECTS)
- AIMS
  - Illustrating the most important laws and principles of classical mechanics
- PREREQUISITES: Mathematics (basic algebra, trigonometry, calculus)
- PROGRAM DETAILS
  - General concepts and physical quantities. Kinematics. Dynamics of the particle. Work and energy. Collisions. Rigid body. Fluids. Mechanical waves.

Optical and Ophthalmic Systems with Laboratory

Lecturer: Emiliano Bonera
Course: Optical and Ophthalmic Systems with Laboratory **credits**: 6
Modules: Optical and Ophthalmic Systems
Didactic activity: lectures 3 ECTS (8h/ECTS)
1° year II semester
Examination: oral examination, evaluation: mark
Aims: Provide students with the basis for understanding the concepts of geometrical optics relative to optical and ophthalmic systems.
Prerequisites: Methods and concepts relative to Mathematics and Geometrical Optics with Laboratory.
Program details:: Ophthalmic lenses. Shape, power. Approximated power, equivalent power, back-vertex power. Lens clock. Lensmeter. Prescription, TABO system. Spherical equivalent. Prismatic deviations. Ophthalmic Prisms. Prentice rule. Boxing. Shape and power. Aberrations. Refractive index and Abbeôs number. Spherical lens design, cylindrical lens design, Tscherning ellipse. Magnification, aniseikonia, anisometropia. Aspheric and athoric lenses. Materials. Bifocals. Progressive lenses. Filters. Sunglasses.

Modules: Laboratory of Optical and Ophthalmic Systems
Didactic activity: laboratory activity 3 ECTS (12h/ECTS)
Examination: oral examination
Aims: The student will be able to practically operate with typical laboratory techniques relative to optical and ophthalmic systems.
Prerequisites: Methods and concepts relative to Mathematics and Geometrical Optics with Laboratory.
Program details: Lens curvature and thickness. Lens parameters calculations. Lensmeter. Centering. Boxing. Prismatic deviations. Interpupillary distance.

Textbook:

- Stephens, Borish ñ Clinical Refractionò Cap. 23 (Butterworth Heinemann)

Suggesting readings

- Keirl, Christie, Clinical Optics and Refraction (Elsevier)
- Notes provided by the lecturer
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Visual Perception

Lecturer: Emanuela Bricolo
Course: Visual Perception **credits**: 6
Modules: single module
Didactic activity: lectures (8h/ECTS)
2° year I semester
Examination: The exam is composed by a written test consisting of multiple choice and essays questions on the course topics. The oral examination is modulated based on the outcome of the written test, evaluation: mark
Aims: The course aims to provide basic psychological knowledge necessary to understand the functioning of visual perception. It provides the tools for successful interaction with other professionals (psychologists, neuroscientists and neuropsychologists) for clinical and research purposes.
Prerequisites: none.
Program details: The methods of psychological research: formulating and testing hypotheses (scientific method), psychophysics
Models of perception
Gestalt and perceptual organization
Perceptual constancy and phenomenology
Psycho-physiological bases of visual perception (color, brightness, shape, depth, movement and object recognition).
Relationship between sensation, perception, attention
Visuospatial attention and eye movements
Neuropsychology of vision, disturbances of visual perception and visual-spatial disorders resulting in brain injury, differential diagnosis of the peripheral and central disorders of the dorsal visual pathway, assessment and rehabilitation of visual field defects, the pseudo-hemianopia, using prisms and occlusion of a hemifield for visual rehabilitation of the unilateral spatial neglect , eye movements in the diagnosis and neuropsychological rehabilitation.
Testbooks: The bibliography will be presented to students during the first lesson of the course and published on the pages associated with the e-learning site.

General Physical Techniques for Optometry

Lecturer:

- Course: General Physical Techniques for Optometry
- 2 year; I,II semester
- Examination: written and oral; evaluation: mark
- Didactic activities: lectures 12 ECTS (8h/ECTS)
- AIMS
    - The course has the purpose to provide the basic concepts of optometry for the following teachings of optometry and the theoretic and practical knowledge of optometric instruments.
    - Comprehensive course covering the routine optometric eye exam, providing the foundation and general principles of refractive care as well as the detection and the management in vision care problems
- PREREQUISITES: none
- PROGRAM DETAILS

- General view of the studies on the historic data of the eye; analysis, consideration and explanation of the statistical data on refractive status; optical defects of the eye; accomodation, its theories and implications on vision; convergence, its theories and implications on vision; forias, its theories and relations with accomodation and convergence; relation between accomodation and convergence; use of lenses during a normal examination of the refraction status using the vary instruments and correspondence with spectacles lenses; myopia; hyperopia; presbyopia; astigmatism; anisometropia and aniseikonia. Use of instruments in modern optometric practice: ophtalmoscopes; retinoscopes; keratometers; slit lamps; trial case lenses and refracting units; screeners.
- Optomteric eye exam: Section I introduction, case history. Entrance test, refraction: principles of refraction, Section II Routine distance subjective refraction with phoropter: step by step procedure : monocular distance subjective refraction, binocular balance, side trips from the routine distance subjective refraction.
- Section III functional tests: phorias , vergences, accomodation. Included accomodation facility
- Determining the add for the presbyope
- Section IV ocular health assessment: principles about slit lamp examination, direct ophtalmoscopy, 90-78D diopter lens.
- Schematic eye: description
- Refractive eye status : physiology, classification and evaluation modalities for
- Emmetropia
- Myopia
- Hypermetropia
- Astigmatism
- Presbiopia
- Visual Acuity: classification and methods of mesurement evaluation
- Contrast Sensitivity: physiology and evaluation modalities
- Refractives Ametropias : Incidence, distribution, onset and progression
- Ophtalmic :description of the most commun opthalmic compensation
- Anisometropia and Aniseikonia : classification, mesurement and optic compensation methods through afocal magnificant lenses
- Ocular Aberration: incidence and physiologicals dynamics
- Accomodation: classification, physiology and function mechanism
- Convegence: classification, physiology and functional mechanism
- Accomodation/Convergence interaction models for neuro-physiologic circuits

- Stimulus/response
- Fusion mechanism and binocular vision : motor and sensory system, stereopsi and evaluation modalities
- Ocular Motility: muscles physiology and innervation, anomalies classification and evaluation modalities
- Color Vision: physiology, anomalies classification and evaluation modalities
- Pseudo-Isochromic test, anomaloscope and monitor test
- Verriestôs classification
- Electrophysiology: electro oculogram, electroretinogram, Evoked potential
- Neurologic eye pathways: physiology, classification and anomalies identification modalities
- Visual Field: physiology, anomalies classification and evaluation modalities
- Refraction : evaluation methods
- Functional test at phoroptero and free space : finalities and evaluation modalities
- Optometric analysis methods: graphic model, OEP analysis, norms, fixation disparity analysis, differential diagnosis
- History: symptoms and evaluation modalities
- Anterior segment evaluation: physiology and evaluation modalities
- Non strabismic binocula anomalies: classification, evaluation modalities and treatment for
- Convergence excess
- Divergence excess
- Convergence Insufficiency
- Divergence insufficiency
- Basic Exophoria
- Basic Esophoria
- Vergence Dysfunction
- Accomodatives Dysfunction
- Prescription: evaluation modalities for binocular anomalies

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- **Laboratory of Physical Techniques for Optometry**
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- Lecturer:
- Course: Laboratory of Physical Techniques for Optometry
- II year; I,II semester
- Examination: written and oral; evaluation: mark
- Didactic activities: laboratory activities 8 ECTS (12h/cfu)
- AIMS
    - The course is based on experiences conducted in optometric laboratory particularly addressed to techniques and instruments used in conducting the analysis of the vision systems and to individuation of its dysfunctions.
- PREREQUISITES: none
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- PROGRAM DETAILS
    - Lensometry: power reading on frame glasses recognition modalities
    - Optometric Instrumentation: optic principles, utility and use modalities
    - Execution modalities for below clinical tests:
    - Visual Acuity tests
    - Pinhole test
    - Accommodative Amplitude evaluation methods
    - Color Vision test
    - Cover Test
    - Stereo tests
    - Worth test
    - Near Point of Convergence
    - External Ocular Motor Test
    - NSUCO test
    - Fixation evaluation tests
    - Pupillary test
    - Visual Field test
    - Interpupillary distance measurement
    - Keratometry
    - <u>II modulus:</u>
    - Monocular and Binocular MPMAV
    - Duochrome test
    - Jackson Cross Cylinder
    - Binocular Balance test
    - Trial frame refraction
    - Prism Dissociated Duochrome test
    - Clock Chart test
    - Stenopaic slit refraction
    - Fused Cross Cylinder
    - Determining the Add for the presbyope
    - Measuring modalities for AC/A ï CA/C
    - Static Retinoscopy
    - Mohindra Retinoscopy
    - MEM Retinoscopy
    - NOTT Retinoscopy
    - Distance lateral phoria by Von Graefe and Maddox technique
    - Distance vertical phoria by Von Graefe and Maddox technique

- Near lateral phoria by Von Graefe and Maddox technique
- Near vertical phoria by Von Graefe and Maddox technique
- Fusional vergence facility test
- Accommodative facility test
- Negative relative accommodation / Positive relative accommodation tests
- Fixation Disparity test
- Glare recovery test
- Contrast Sensitivity test
- Perimetry
- Autorefraction
- Anterior segment Biomicroscopy (Slit lamp).

General optics of contact lens fitting

- Lecturer:
- Course: General optics of contact lens fitting
- II year; I,II semester
- Examination: written and oral; evaluation: mark
- Didactic activities: lectures 12 ECTS (8h/ECTS)
- /AIMS
  - To provide a solid background on the morphological, structural analysis of cornea, tear film and ocular parameters required for a correct contact lens fitting.
- PREREQUISITES: none
- PROGRAM DETAILS
- **I module**:
  - Introducing contact lenses
  - History and development of contact lenses
  - Terminology
  - Processing of contact lens
  - Inspection and verification
  - Polymer chemistry
  - Contact lens design
  - Optical phenomena of contact lenses
  - References to corneal anatomy and physiology
  - Initial evaluation and patient selection
  - Case history
  - Indications for contact lens wear
  - Preliminary measurement
  - References to instrumentation
  - Assessment of tear film
  - Fitting set composition
  - Spherical ametropia
  - Fitting procedure of traditional rigid gas-permeable contact lens
  - Procedures for inspection and verification
  - Fitting procedure of traditional soft contact lens
  - Procedure for inspection and verification
  - Advanced instrumentation in contact lens practice
  - Contact lens care regimens and patient education
  - Patient follow-up
  - Contact lens solution chemistry
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II module:

  - Astigmatism management
  - Rigid gas-permeable and astigmatism
  - Soft toric contact lens correction
  - Procedure for inspection and verification
  - Advanced contact lens
  - Keratoconus management, fitting procedures
  - Presbyopic correction, fitting procedures
  - Contact lens induced corneal reshaping
  - Contact lens for ocular trauma, disease and surgery
  - Cosmetic contact lens

- Contact lens for paediatrics
- Hybrid contact lenses
- Therapeutic contact lenses
- Scleral and mini-scleral contact lenses
- References to droop-out
- References to complication of contact lens wear
- Management of complications of contact lens wear
- References to dry eye
- Surface deposits
- Practice management
- Legal issues in contact lens practice

▪ Mathematics II

- Lecturer: Simone Secchi
- Course Mathematics II
- 2 year; I,2 semester
- Examination: written and oral; evaluation: mark
- Didactic activity: lectures 5 ECTS (8h/ECTS), exercitations 3 ECTS (12h/ECTS)
- AIMS
  - To provide the bases of calculus
- PREREQUISITES: Mathematics I

- PROGRAM DETAILS
- **Power series.** Representation of functions as power series. Taylor series and Maclaurin series of elementary functions. The binomial series. Applications of Taylor polynomials.
- **Linear algebra.** Vectors in two and three dimensions. Linear dependence. Matrices and determinants. Rank of a matrix. Inverse matrix. Linear transformations and examples in the plane. Systems of linear equations: Rouché- Capelli theorem and Cramer rule. Eigenvalues and eigenvectors of 2×2 matrices.
- **Differential equations.** First-order equations and initial value problem. The Malthus model. Certain types of equations: separable equations and linear equations. Second-order equations with constant coefficients: general solutions of homogeneous equations

Physics II

- Lecturer: Alessandro Borghesi
- Course: Physics II
- II year; I,II semester
- Examination: written and oral; evaluation: mark
- Didactic activities: lectures 6 ECTS (8h/ECTS) exercitation 2 ECTS (12h/ECTS)
- AIMS
  - In this course the basic concepts of Electromagnetism are presented and discussed. Numerical examples and exercises are also discussed
- PREREQUISITES
  - Mathematics and solid bases on: Kinematics. Dynamics of the particle. Work and energy. Collisions. Rigid body. Fluids. Mechanical waves.
- PROGRAM DETAILS
  - 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. 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. Magnetization. Magnetic materials.
  - Maxwell equations. Induced magnetic field. Electromagnetic waves. Energy transport and Poynting vector.

▪ Laboratory of Physical Techniques for Contact lens Fitting

- Lecturer:
- Course: Laboratory of Physical Techniques for Contact lens Fitting
- II year; I,II semester
- Examination: written and oral; evaluation: mark
- Didactic activities: laboratory activities 8 ECTS (12h/ECTS)
- AIMS
    - To provide the practical and theoric knowledge on materials and their geometries of soft and semi hard and gas permeable contact lens. Preliminary tests for contact lens fitting will also provided.
    -
- PREREQUISITES: none
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- PROGRAM DETAILS

  I module:
    - The role of case history and selection of patient in contact lens practice.
    - Initial evaluation.
    - Corneal curvature, keratometry and topography.
    - Slit-lamp evaluation, external examination.
    - Tear film observation and assessment.
    - Assessment of ocular reactions by means of grading scale.
    - Vital dyes.
    - Inspection and verification of gas-permeable contact lens.
    - Inspection and verification of soft contact lens.
    - Traditional contact lens
    - Material types and selection.
    - Benefits and limitations of gas-permeable contact lenses.
    - Benefits and limitations of soft contact lenses.
    - Application of spherical lenses (spherical ametropia).
    - Methods of observation.
    - Pattern evaluation and fitting philosophy.
    - Assessment of visual correction.
    - Power determination and lens order.
    - Problem solving.
    - Spherical disposable contact lenses
    - Benefits and limitations of soft disposable contact lenses.
    - Application of disposable contact lenses.
    - Methods of observation.
    - Pattern evaluation and fitting philosophy.
    - Relationship between tear film and frequent replacement materials.
    - Frequent replacement hydrogel and silicone hydrogel lenses
    - Assessment of visual correction.
    - Power determination and lens order.
    - Problem solving.
    - Patient management
    - Patient education.
    - Drop-out prevention.
    - Soft contact lens care regimens.
    - Rigid gas-permeable contact lens care regimens.

- Contact lens follow-up care and problem solving.
- Special instrumentation: wave front analysis, tearscope and endothelial microscopy
- Dry eye management.

II module

- Traditional contact lens
- Application of toric contact lenses (astigmatic ametropia).
- Material types and selection.
- Benefits and limitations of gas-permeable contact lenses.
- Benefits and limitations of soft contact lenses.
- Methods of observation.
- Pattern evaluation and fitting philosophy.
- Assessment of visual correction.
- Power determination and lens order.
- Problem solving.
- Advanced disposable contact lenses
- Frequent replacement lenses and astigmastism.
- Presbyopic correction.
- Cosmetic contact lenses.
- Advanced contact lens application
- Keratoconus management and fitting.
- Hybrid materials and design.
- Fitting philosophy and Fitting techniques.
- Presbiyopic correction.
- Contact lens application for ocular trauma, disease and surgery.
- Contact lens induced corneal reshaping.
- Scleral and mini-scleral lenses.
- Paediatric contact lenses.
- Management of contact lenses for extended wear.
- Management
- References to diagnostic pharmaceutical agents relevant to contact lens practice
- Environment influence on contact lens wear
- Clinical research methodology and statistics
- Management of lens induced complications

Principles of Ocular Pathology

- Lecturer: Stefano Miglior
- Course: Principles of Ocular Pathology
- 3year; I semester
- Examination: written and oral; evaluation: mark
- Didactic activity: lectures 4 ECTS (8h/ECTS)
- AIMS: To provide basic concepts and aspects of ocular pathology
- PREREQUISITES: Anatomy and Histology, and Physiology
- PROGRAM DETAILS
  - 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 optical nerve; neuro-sensory visual pathology; oculamotor neuropathology.

Light-Matter Interactions

- Lecturer: Francesco Meinardi
- Course: Light-Matter Interactions
- 3 year; I semester
- Examination: written and oral exam; evaluation: mark
- Didactic activities: lectures 6 ECTS (8h/ECTS)
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- AIMS
- Main goal of this course is the description of the processes by which light interacts with atoms, molecules and materials. Lectures start from the discussion of phenomena which can be analyzed by using Maxwellôs equations, then of those requiring a more sophisticate approach to finally arrive at the vision photophysics.
- PREREQUISITES: good knowledge of the Physics II course (electromagnetism) and in particular of Maxwellôs equations
- PROGRAM DETAILS

1) Wave-particle duality (basic elements) and mathematical representation of waves: Real and complex wave representation; Phase and phase velocity of waves. Scalar and vectorial waves; Polarized plane waves.
2) Electromagnetic waves: Maxwell equations (brief review), Wave equation; Wave propagation in vacuum and in real material; Complex refraction index and complex dielectric function; Dispersion and attenuation of electromagnetic waves in the materials; Lorentz and Drude models.
3) Transmission and reflection: Electromagnetic wave transmission; Absorption coefficient and Lambert-Beer law; Interface reflectivity at normal incidence; Transmittance, reflectance, and absorbance spectra; Refraction and reflection of linearly-polarized light at oblique incidence; Fresnel equations; Brewsterôs law and light polarization by reflection; Refraction induced colors.
4) Optical Anisotropy: Bravais lattices (basic elements); Dielectric tensor in anisotropic media; Light propagation in anisotropic media; Birefringence; Waveplates; Dicroic polarizer.
5) Light scattering: Rayleigh scattering; Raman scattering (basic elements); Mie scattering; scattering induced colors.
6) Light interactions with atoms and molecules: Introduction to optical spectroscopy; Hundôs rules; Atomic transitions and selection rules; Light produced by gas excitation and comparison with the black-body emission; Introduction to the laser physics; Molecular transitions; Beyond isolated atoms/molecules: colors in metals, semiconductors and insulators.
7) Vision: Photophysics of the vision; Scotopic an photopic vision; Colorimetry; Color mixing.
8)

Textbook and Suggested reading

Textbooks: F.W. Sears, Ottica, Ed. CEA
K. Nassau, ñThe Physics and chemistry of colorsò, J. Wiley & Sons, Inc.
Lecture notes.

HYSTORY OF THE MODERN OPTICS AND THE OPTICAL INSTRUMENTATION
Active from 2017-2018 academic year

Lecturer: Prof. Silvia Tavazzi silvia.tavazzi@unimib.it
Course: HYSTORY OF THE MODERN OPTICS AND THE OPTICAL INSTRUMENTATION
III year, I sem
Didactic activities: lectures 6 ECTS (8h/ECTS)
Exam: written and oral exam

Description of the course:

- HYSTORY OF THE FIRST DEVICES to improve vision: mirrors and lenses (from Sumerians to the lens of Layard to the ñsmaragdusò of Nerone)
- HYSTORY OF GLASS from the Phoenicians, the Mesopotamian region, the Egypt, the Etruscans, the Roman Empire to Venice, to the telescopes of the seventeenth century, to the Nord of Europe, to Zeiss, Abbe, and Schott
- HYSTORY OF SPECTACLES from the rivalry between Veneto and Tuscany to the modern spectacles
- HYSTORY OF THE CONTACT LENSES from the idea of Leonardo da Vinci to the contact lenses of Zeiss, to the plastic ones and the modern soft contact lenses
- DEVELOPEMNT OF THE LIGHT SOURCES from oil and gas lamps to the use of electricity (Volta and Davy, Edison and the incandescent lamp) to fluorescent lamps, LED and LASER
- THE OPTICS OF THE SEVENTEENTH CENTURY AND THE DEVELOPMENT OF TELESCOPES AND MICROSCOPES from Galileo, Keplero, Snell, Cartesio, Fermat, Grimaldi and Roemer to Huygens and Newton, Campani and Cassini, Cassegrain, etc.
- THE OPTICS OF THE NINENTEENTH AND TWENTIETH CENTURIES, INTERFERENCE AND DIFFRACTION, PHOTOELECTRIC EFFECT, COMPTON EFFECT, BLACK-BODY RADIATION: from Young, Fresnel, Fraunhofer, Brewster, Maxwell, Hertz, Rayleigh, Michelson (interferometer) to De Broglie, Planck, Einstein
- DEVELOPMENT OF DEVICES AND INSTRUMENTATION FOR OPTICS, OPTOMETRY, AND OPHTHALMOLOGY from the mechanical and optical classical instrumentation to the modern fundus camera, Shack-Hartmann ocular aberrometer, and to the modern technique of the optical coherence tomography (OCT).

Textbooks:

- Gettys, Keller, Skove, ñFisica classica e modernaò vol. 2
- Notes and material provided by the lecturer (E-learning platform)

▪ Advanced Physical Techniques for Optometry

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- Lecturer:
- Course: Advanced Physical Techniques for Optometry
- III year; I semester
- Examination: written and oral; evaluation: mark
- Didactic activities: lectures 4 ECTS (8h/ECTS); laboratory activities 4 ECTS (12h/ECTS)
- AIMS
    - Comprehensive course covering accommodative, ocular motility and non strabismic conditions, providing the foundation and general principles for detection, case analysis and management of visual disorders

- PREREQUISITES: General Physical Techniques for Optometry
- PROGRAM DETAILS
    - Posterior segment evaluation : physiology and evaluation modalities
    - Paediatric binocular vision : evolution and anatomical perceptual characteristics
    - Strabismic binocular anomalies: classification and evaluation modalities for
    - Esodeviation ï Infantile, accommodative and acquired
    - Exodeviation ï Sensorial and Secondary
    - Vertical deviation ï DVD and Oblique dysfunction
    - Syndromes: V and A pattern and Duane syndrome
    - Nistagm: congenital, latent and sensorial
    - Amblyopia: classification, evaluation modalities and teatment through Visual Training and occlusion techniques
    - Yoked Prism: functional mechanism effects visual perceptual sistem and prescription modalities
    - Visual Training: philosophic approaches and treatment modalities
    - Ocular motor procedures
    - Accommodative procedures
    - Fusional procedures
    - Pharmacologic principles and their effects on eye (a short account)
    - Low Vision: evaluation modalities, prescription and compensation modalities

▪ Optical Instruments and Their Hystorical Evolution

Active till Academic Year 2016-2017

- Lecturer: Prof.ssa Silvia Tavazzi
- Course: Optical Instruments and Their Hystorical Evolution
- 3 year; I semester
- Examination: oral exam; evaluation: mark
- Didactic activities: lectures 6 ECTS (8h/ECTS)
    - n. cfu esercitazioni (12 ore/cfu)
- AIMS
    - The course is aimed at describing the strong interaction between the theory on the vision process and the instruments developed for studying and enhancing vision
- PREREQUISITES: Geometrical Optics
- PROGRAM DETAILS

- A brief introduction is devoted to the vision problems, to optical illusions, and to the optics laws involved in the eye vision. Then, the hystorical development of models proposed to interpret the vision mechanism and the light theory is illustrated, starting from the emissionistic and immissionistic hypotheses of the main greek philosophers up to the contributions from the scientists of XIX and XX centuries. At the same time, the hystorical evolution of the first devices used as a vision support and of the instruments for observing very close and very far objects is reviewed. Finally, the evolution of the instruments for optometry and for electrophysiological diagnostic are described with the ways they work
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Suggested reading
Notes provide by the Lecturer

▪ Physics III with laboratory

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Active till Academic Year 2016-2017

- Lecturer: Maurizio Acciarri
- Course: Physics III with laboratory
- III year; I semester
- Examination: oral exam; evaluation: mark
- Didactic activities: lectures 4 ECTS (8 h/ECTS), laboratory activities 2 ECTS (12h/cfu)
- AIMS
  - Starting from the Maxwell equations to provide the basics of electromagnetic waves properties and their interaction with matter
- PREREQUISITES: Mathematics (basic algebra, trigonometry, calculus), basic Physics including waves and electromagnetism
- PROGRAM DETAILS
  - Electromagnetic waves: em. Spectrum, generation, propagation and detection of em. waves. Wave-matter interaction: absorption, reflection, .transmission, diffusion. Polarization :linear, circular, elliptical, random. Anisotropic media, birifrangence, dicroism, retarder plates. Interference and diffraction: slits, gratings, monocromators. Blackbody emission spectrum, radiancy (total and monocromatic), Planck constant. Photoelectric effect and particlelike properties of radiation. Atomic spectra, Balmer and Rydberg formulae. The hydrogen atom ed the Bohr model. X-ray spectra, Compton effect..