



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Scienze Biomediche 1

2122-1-I0101D001

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#### Aims

The student must achieve the knowledge of the histological and anatomical bases essential for the study and understanding of the human physiology and pathology. He must also know: the structure and function of cellular components and molecular mechanisms; the chromosomal disorders; the concepts and methods of transmission of hereditary characteristics and of pathogenic mechanisms "non-traditional"; the qualitative and quantitative knowledge of biological phenomena.

#### Contents

The course aims to describe the organization of the human body; to explain how are cells and tissues organized to form organs and systems; to underline the functional correlations of micro- and macroscopic anatomy. It also aims to transmit the knowledge of the structure and function of the various components of eukaryotic cells, the molecular mechanisms involved in cell replication, the molecular mechanisms involved in gene expression; the chromosomal disorders and transmission pattern in Mendelian monogenic diseases as well as the basis for the qualitative and quantitative knowledge of biological phenomena for a correct application of therapies.

#### Detailed program

HUMAN ANATOMY: General Anatomy - Anatomic terms; planes, lines and anatomical landmarks; terms related to movement; principles of organization of the human body: cells, tissues, organs, systems; serous cavities and connective spaces, their location and content. Muscularskeletal system - Classification of the bones, muscles and joints. The skull: cranium and facial bones: general architecture of the skull and main characteristics of the

individual bones; base of the skull: cranial fossae and major foramina with the structures that each transmits; cranial sutures; neonatal skull; nasal cavity, orbital cavity, paranasal sinuses; temporomandibular joint; general features of mimic and

masticatory muscles. The vertebral column: general characteristics of the vertebrae and regional differences; atypical cervical vertebrae: atlas and axis; joints of the vertebral column; general features of the muscles of the back. Neck: main characteristics of the muscles of the neck. Chest: bones and cartilages of the thoracic cage; joints of the ribs and costal cartilages; muscles of the thorax, respiratory muscles, in particular diaphragm muscle. Shoulder girdle and upper limb: main characteristics of the different bones; shoulder and elbow joints, main features of the other joints; muscles of the shoulder, the rotator cuff, arm muscles, general features of forearm and hand muscles. Pelvis and lower limb: study of the hip bones in detail, main characteristics of the other bones; joints and ligaments of the pelvis, hip joint, knee joint, main features of the other joints; hip and thigh muscles, muscles of the leg, general features of foot muscles; Scarpa's triangle and adductor canal. Abdominal wall: anterolateral and posterior abdominal wall muscles; inguinal ligament; inguinal canal. Pelvic floor: pelvic diaphragm; perineum. Cardiovascular system - Heart: surface, structure, chambers of the heart, conducting system; heart vessels; pericardium; mediastinum: definition, borders and contents. Blood vessels: vessels structure (arteries, veins and capillaries); pulmonary and systemic vascularization, with major focus on: aorta and its branches; Polygon of Willis; blood supply of the upper and lower limbs; blood supply of the organs; superior and inferior vena cava venous system; portal vein system; anastomosis. Lymphatic system - General organization of the lymphatic drainage. Thoracic duct. Position, relations, macroscopic and microscopic anatomy of the lymphoid organs: thymus, spleen, lymph nodes and tonsils; main lymph node chains. Respiratory system - Nose, nasal and paranasal cavities. Position, relations, macroscopic and microscopic anatomy of the organs of the respiratory tract: pharynx, larynx, trachea, bronchi, lungs. Blood supply of the organs. Visceral and parietal pleura. Digestive System - Oral cavity. Salivary glands. Position, relations, macroscopic and microscopic anatomy of the organs of the gastrointestinal tract: esophagus, stomach, small intestine (duodenum, jejunum, ileum), large intestine (cecum, appendix, colon and rectum). Other organs of the digestive system: liver, bile ducts, gallbladder, pancreas; their position, relations, macroscopic and microscopic anatomy, with focus on the different types of hepatic lobules. Blood supply of the organs.

Peritoneum: general arrangement, ligaments, omenta, esenteries, intraperitoneal and retroperitoneal relationships of the different organs. Urinary system - Position, relations, macroscopic and microscopic anatomy of the organs of the urinary tract: kidneys, with focus on the structure of the nephron, bladder, ureter, male and female urethra. Blood supply of the organs. Endocrine system - General characteristics of hormones. Position, relations, macroscopic and microscopic anatomy of the endocrine organs: pituitary gland and its connection with the hypothalamus, thyroid, parathyroid, adrenal gland, endocrine pancreas, pineal gland. Blood supply of the organs. General characteristics of GEP system. Female reproductive system - Position, relations, macroscopic and microscopic anatomy of the female genital organs: ovary, uterus, fallopian tube, vagina. Blood supply of the organs. External genitalia: morphology, relations and structure. Main characteristics of placenta. Male reproductive system - Position, relations, macroscopic and microscopic anatomy of the male genital organs: testis, epididymis, vas deferens, prostate, seminal vesicles and bulbourethral glands. Structures of the spermatic cord. Blood supply of the organs. External genitalia: morphology, relations and structure. Integumentary system - Skin and its appendages. Mammary gland: position, relations, macroscopic and microscopic anatomy. Blood supply of the skin and mammary gland. Nervous system - General morphologic and functional organization. Synapses, neurotransmitters and anatomical basis of the reflex arch. Central nervous system - Basic concepts on nervous system development. Position, relations, gross morphology, major features concerning microscopic organization and main functions of the following structures: spinal cord; hindbrain: medulla, pons, cerebellum, IV ventricle; midbrain; diencephalon; forebrain. Meninges: architecture and functions. Cerebrospinal fluid (CSF): composition, circulation and functions.

Peripheral nervous system - Cranial nerves, spinal nerves plexuses) and their territory of innervation. Autonomic nervous system: general architecture and innervation of organs. Special senses - Eye: the orbit and its contents, basic concepts on the structure of the eye-ball and its muscles. Lacrimal apparatus. Ear: general structure and components of the outer, middle, inner ear. HISTOLOGY: General features of eukaryotic cell: shape, size and lifespan. Main characteristics of the structure, ultrastructure and function of the major cell constituents (plasma membrane, cytoplasm, cytoskeleton, rough and smooth endoplasmic reticulum, Golgi apparatus, lysosomes,

mitochondria, nucleus). Basic concepts on the origin of human tissues. Structure, classification, localization and functions of: Epithelial Tissue: lining epithelium, glandular epithelium; Connective tissue: proper connective tissue, adipose tissue, cartilage, bone tissue (osteogenesis), blood and haemopoiesis; Muscle tissue: skeletal muscle, smooth muscle, cardiac muscle; Nervous tissue: neurons (cell body, dendrites, axons), structure of nerve fibers, synapses and nerve transmission, glial cells. **BIOLOGY AND GENETICS:** General Biology - Key features of living matter: the cell as a structural and functional unit; classification of prokaryotic and eukaryotic cells. Characteristics of the various components of the cell: cell membrane, its formation and characteristics; transmembrane transport and endocytosis; structure and function of the endoplasmic reticulum and the Golgi apparatus; structure and function of mitochondria and lysosomes; cytoskeleton, intermediate filaments microfilaments, microtubules; structure of nuclear membrane. DNA replication: the various protein components that are involved in DNA replication; the processes that take place at the level of the filament and filament delayed of replicative senescence fork. The genome organization in prokaryotes and eukaryotes: in the eukaryotic organisms, the genetic information is divided among multiple DNA molecules (chromosomes); the problem of compaction of DNA in the nucleus of eukaryotic cells; the information contained in DNA is divided into discrete units (genes) that specify the individual macromolecules structure RNA or proteins). Regulation of gene expression in prokaryotic and eukaryotic cells. The main types of RNA present in cells; differences compared to DNA: the mechanism of synthesis of RNA (transcription); the problem of deciphering the genetic code: general characteristics and biological implications. The mechanism of protein synthesis: the strategy of polymerization of amino acids: amino acid recognition by the messenger RNA and the source of the energy necessary for the formation of peptide bonds; the biological role and structure of ribosomes; the different stages of the translation process. The cell cycle and metabolic events that characterize its phases: control the progression along the cell cycle; consequences of mutations affecting genes for different proteins involved. Cell reproduction and agencies: mitosis as maintenance of genetic information. Meiosis and the crossing-over in the process of genetic variability. The gene mutation at the cellular level: the effects of mutations on the gene product. Communication between cells in the multicellular organisms: notes on exchanging chemical signals with autocrina and paracrina: overview of general mechanisms of signal translation within cells. **MEDICAL GENETICS** - Introduction to Genetics. Notes of Mendel's laws. Blood group Genetics, Rh and MN antigens, notes on the reproduction physiology. Karyotype: history, techniques, clinical indication for pre-and and postnatal diagnosis. Numerical and structural chromosomal abnormalities and clinical consequences on phenotype and reproduction. Notes on sex development, sex chromosomes aneuploidies and related syndromes; X-chromosome inactivation. Different types of monogenic Mendelian Inheritance (family trees and examples of genetic diseases): autosomal dominant; autosomal recessive; X-linked recessive; X-linked dominant. Non-mendelian genetic diseases caused by expansion of triplets and imprinting: examples of syndromes. **BIOCHEMISTRY:** The atomic structure, its importance in relation to the chemical behavior of the elements. The interactions between atoms that give rise to the formation of compounds. The solution behavior of compounds with particular reference to aqueous solutions of acids and bases, buffer solutions. Qualitative and quantitative aspects of chemical reactions. The classification of organic compounds addressed the structure of compounds of biological interest: proteins, lipids and carbohydrates. Knowledge of energy metabolism and enzymes, of the regulation of metabolism through the hormonal system and of the principles of nutrition. Chemistry: knowledge of the composition of the matter, of the atomic structure and main chemical bonds (ionic, covalent, and hydrogen bonds). Basic knowledge of the nomenclature. Definition of atomic and molecular weight, and mole. Mixtures: classification and definition of solution, and solubility. Properties of solutions: osmotic pressure. How to express the concentration of a solution. Chemical reaction: reversible and irreversible reactions, activation energy. Law of conservation of mass. Endergonic and exergonic reactions. Definition of equilibrium constant and kinetics. The chemical equilibrium: effect of changes of concentration, temperature and catalysts. Oxidation-reduction (redox) reaction. Acids, bases, buffers: Definitions of acids and bases (conjugate acid-base pairs) and their solutions. Definition of pH. Acids and bases strengths. Buffer solutions: definition. Organic chemistry: classification of organic compounds and main functional groups: saturated and unsaturated compound, aromatic hydrocarbons, alcohols and thialcols, carbonyl compounds, carboxylic acids, amines, aldehydes, ketones, esters, ethers. Isomers. Stereoisomerism. Protein: amino acid structure. Intramolecular and intermolecular bonds. Isoelectric point. Definition of primary structures, secondary, tertiary, quaternary. Lipids: classification. Hydrolysis of complex lipids. Free fatty acids: nomenclature, saturated, unsaturated. Simple and complex lipids. Steroids. Carbohydrates: classification, aldose and ketoses. Isomers (D and L). Open and closed structures: ? and ? anomers. Glycosidic bond and major disaccharides. Structural polysaccharides and energy reserve. Biochemistry: introduction course and general information on living matter. Biochemical reactions, enzyme, Enzyme Kinetics, regulation. Bioenergetics, oxidative phosphorylation, respiratory chain. Carbohydrates: digestion, absorption, aerobic and

anaerobic glycolysis; gluconeogenesis. Pentoses phosphates Shunt. Glycogen and blood glucose regulation. Lipids: digestion, absorption; lipolysis; biosynthesis; the Krebs cycle; ketone bodies; cholesterol; phospholipids; glycolipids; lipoproteins. Proteins: digestion, absorption; metabolism; the urea cycle. Nucleotides: synthesis and catabolism. Second messengers and hormones. Nutrition and vitamins.

## **Prerequisites**

## **Teaching form**

Face-to face lessons

## **Textbook and teaching resource**

HUMAN ANATOMY – One of the following books: Ambrosi G. et al. Anatomia dell'uomo (2006) Ed. Edi-Ermes; Bentivoglio M. et al. Anatomia umana e Istologia (2010) Ed. Minerva Medica; Gilroy A.M. Elementi di Anatomia umana (2017) Ed. Edises; Martini F.H. et al. Anatomia umana - VI ed. (2016) Ed. Edises; McKinley M., O'Loughlin V.D. Anatomia umana (2014) Ed. Piccin; Saladin K.S. Anatomia umana (2011) Ed. Piccin; Seeley et al. Anatomia - III ed. (2014) Ed. Idelson Gnocchi. HISTOLOGY - Sica G. et al. Istologia (2014) Idelson Gnocchi. BIOLOGY – Chieffi G., Dolfini S., Malcovati M., Pierantoni R., Poli M., Tenchini M.L. Biologia e Genetica (2013) Edises - IV ed. MEDICAL GENETICS - Chieffi G., Dolfini S., Malcovati M., Pierantoni R., Poli M., Tenchini M.L. Biologia e Genetica (2013) Edises - IV ed. BIOCHEMISTRY - Bertoldi M., Colombo D., Magni F., Marin O., Palestini P. Chimica e Biochimica (2015) Edises; Nelson D.L. and Cox M.M. Fondamenti di Biochimica di Lehninger (2021) Ed Zanichelli.

## **Semester**

1 Year - 1 Semester

## **Assessment method**

Written examination: multiple choice and open ended questions.

## **Office hours**

On appointment

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