Syllabus Master's Degree Course in Medicine and Surgery a.y. 2026 - 2027

BODY FUNCTIONS 2

Second year, second semester (15 academic credits [CFU])

Teachers

Subject	Academic credits (CFU)	Lecturer
Human physiology	8	PUZZO Daniela TROPEA Maria Rosaria
Organ structure	5	TBD
Biochemistry	2	AMORINI Angela Maria

Learning outcomes

Subject	Learning outcomes
Human physiology	**Knowledge and understanding** By the end of the course, students are expected to: • Acquire knowledge on how the living organism achieves and maintains homeostasis in relation to internal and environmental changes. • Understand the functioning mechanisms of individual cells, tissues, organs, and the integration between them. • Acquire knowledge on functioning of the cardiovascular, respiratory, renal, gastrointestinal, and endocrine systems and their interactions. • Acquire knowledge on the nutritional characteristics of foods, nutritional status, energy expenditure, energy requirements, and the physiological use of nutrients in the diet. • Understand the adaptations of the body during physical exercise and under extreme conditions. **Applying knowledge and understanding** By the end of the course, students are expected to: • Be able to evaluate how findings from basic science and experimental research can be potentially translated into clinical practice. • Apply the acquired knowledge to understand the pathogenetic mechanisms and the clinical signs and symptoms pathophysiological implications).

Organ structure	**Knowledge and understanding** By the end of the course, students are expected to: • Acquire knowledge on the anatomy and functional mechanisms of the alimentary and urinary systems • Acquire knowledge on the anatomy and functions of the male and female genital systems. • Understand the structure and regulation of the endocrine system. **Applying knowledge and understanding** By the end of the course, students are expected to: • Apply knowledge of anatomical structures to understand pathogenetic mechanisms and clinical signs and symptoms. • Be able to describe the topography, structural organization, and functional integration of the alimentary, urinary, male and female genital, and endocrine systems. • Be able to assess the spatial relationships of these organs with adjacent structures.
Biochemistry	**Knowledge and understanding** By the end of the course, students are expected to: • Acquire knowledge on the integration, hormonal control and intracellular environment/signaling relationship in glucose, lipid and protein metabolism • Understand the different metabolic specialization of the organs, in physiological and pathological situations. • Acquire knowledge on the fate of heme and nitrogenous bases. **Applying knowledge and understanding** By the end of the course, students are expected to: • Apply knowledge of metabolic integration, hormonal regulation, and organ-specific metabolic pathways to understand the pathophysiological mechanisms underlying clinical signs and symptoms. • Apply knowledge of organ-specific metabolic responses to hormonal and nutritional stimuli to explain alterations in metabolic pathways under pathological conditions.

Prerequisites

Subject	Prerequisites
Human physiology	Attainment of the educational objectives set by prerequisite courses.
Organ structure	
Biochemistry	

Course contents

Subject	Course contents
Human physiology	**Blood and Lymph** • Blood composition: cellular components and liquid part, hematocrit, plasma proteins and electrophoretic proteinogram, main laboratory tests, blood count.

	• Red blood cells: erythropoiesis and iron metabolism, hemocateresis, hemolysis, respiratory functions of red blood cells, hemoglobin's affinity for respiratory gases, oxygen uptake and release by hemoglobin. Physiopathological implications: anemia. • White blood cells: distribution and leukocyte formula, functions. Physiopathological implications: infections. • Platelets: functions, hemostasis, and coagulation. Physiopathological implications: antiplatelet and anticoagulant drugs. • The lymphatic system: lymphatic stations, composition, and function of lymph. Blood-tissue barrier. **Cardiovascular system** • Electrical function of the heart: excitability, cardiac automaticity, and pacemaker cells, refractory periods, conduction. • Mechanical function of the heart: cardiac cycle, valve movements and pressure variations in atria and ventricles during the phases of the cardiac cycle, duration of the phases, cardiac output, Starling's law of the heart, Laplace's law applied to the heart. Cardiac output determination and commonly used methods. • Heart sounds: auscultation sites and characteristics. Physiopathological implications: valvular insufficiency and stenosis. • Heart properties: chronotropy, bathmotropy, dromotropy, inotropy. • Pharmacology: beta-blockers, calcium channel blockers, digitalis. • Neural control of the heart: autonomic nervous system, brainstem and hypothalamic centers, reflex regulation of the cardiovascular system. • Heart work, metabolism, and oxygen consumption. • Electrocardiography: Einthoven's triangle, leads, standard electrocardiographic conventions, common trace analysis, axis determination and its functional significance. Echocardiogram. Physiopathological implications: flutter, fibrillation, extrasystole, bundle branch block, myocardial infarction. • Systemic arterial pressure: systolic, diastolic, differential, mean. Short and long-term regulation mechanisms (chemoreceptors, baroreceptors, renin-angiotensin-aldosterone system, bradykinin, catecholamines, dopamine, serotonin). Arterial pulse. Blood pressure determination. Physiopathological implications: arterial hypertension. • Venous system: venous distensibility, posture effects on veins, venous return, phlebogram, venous pressure and its variations, jugular pulse. Physiopathological implications: venous insufficiency. • Special vascular circuits: regional distribution of cardiac output, coronary, cerebral, cutaneous, muscular, hepatosplanchnic, pulmonary, renal, splenic, and fetal circulation. **Respiratory system** • Respiratory mechanics: General considerations. Functions of the upper airways. Generation of pressure gradients: eupneic

inspiration and expiration. Role of respiratory muscles and pleura. Elastic recoil of the lung. Airway resistance. Effects of surface tension on respiration and surfactant's role. Definition of pulmonary compliance and elasticity with clinical applications. Spirometry: lung volumes and capacities. Forced spirometry and pulmonary function tests, notes on obstructive and restrictive conditions. Physiopathology examples for understanding physiological mechanisms.

- External and internal respiration: ventilation-perfusion matching, V/Q ratio and regulatory mechanisms, alveolar compartment, the role of membrane thickness and surface area in gas exchange. Gas partial pressures, solubility, and physical laws applied to respiratory physiology. Role of red blood cells and hemoglobin. Recap of hemoglobin function, oxygen dissociation curve, oxygen saturation, and clinical implications. Hypoxia definition, types of hypoxia, and clinical repercussions.
- Regulation of respiration: Definition of key neural structures for generating respiratory patterns: pneumotaxic and apneustic centers, dorsal and ventral respiratory groups. Neural signal generation and mechanical transduction: respiratory frequency and depth. Central and peripheral chemoreceptors. Other regulatory mechanisms: stretch receptors, irritant agents, juxtacapillary receptors, muscle proprioceptors. Voluntary control of respiration. Hypothalamic and emotional regulation of respiration.
- Clinical applications of respiratory physiology: Respiratory changes during exercise and at high altitude. Clinical examples of pathological breathing patterns and dyspnea. Respiratory assistance devices. Notes on cardiopulmonary resuscitation.

Urinary system

- Renal functions: General overview. Notes on functional anatomy. The nephron as the kidney's functional unit. Differences between cortical and juxtamedullary nephrons. Renal vasculature.
- Glomerular functions: Mechanisms of glomerular filtration. Effective filtration pressure, characteristics of the ultrafiltrate, and resistances to tubular fluid flow. Glomerular filtration rate. Inulin and creatinine clearance. Mechanisms modifying the ultrafiltrate volume. Filtered load concept and its functional significance.
- Tubular functions: Reabsorption processes at the proximal tubule. Active and passive transport. Renal threshold and tubular transport maximum concepts. Glucose reabsorption and glycosuria. Facultative reabsorption in the distal tubule. Aldosterone’s action. Urine concentration. Henle’s loop and countercurrent multiplication mechanism. Vasa recta and countercurrent exchange. Vasopressin’s action. Tubular secretion (hydrogen ions, potassium, ammonium ion). Urine acidification.
- Renal circulation: Extrinsic control and autoregulation of renal blood flow in relation to systemic blood pressure (myogenic mechanism and tubuloglomerular feedback).
- Systemic functions of the kidney: Control of systemic arterial pressure, osmolarity, and composition of body fluids. Erythropoietin production. Endocrine functions.

	• Applied renal physiology: Renal function tests (clearance concepts and their application in assessing glomerular, tubular, and vascular function). Significance of glucose and water load. Osmotic and water diuresis. Fluid deficit (dehydration) and its general consequences. Fluid excess (water intoxication, edema). Notes on pharmacology: diuretics. • Bladder physiology: filling and emptying, nervous system action, paralytic bladder, cystogram. **Gastrointestinal system, Metabolism, and Nutrition** • Digestive processes: Digestive tract. Chewing. Salivary secretion, composition, and function of saliva. Conditioned reflexes. Swallowing. Gastric filling. Gastric movements. Gastric secretion and its neural/hormonal regulation. Pancreatic secretion: secretin and pancreozymin, pancreatic juice. Secretion of the small intestine and colon. Intestinal motility. Gastrointestinal hormones. • Gastroenteric nervous system: Intrinsic and extrinsic innervation. Endoluminal pressure regimes. Villi movements. Types of intestinal movements. Esophageal, gastric, and intestinal motility. Myogenic and neurogenic mechanisms of intestinal movement. Visceral reflexes. Colon motility. Defecation. • Liver: The liver's functional unit. Hepatic arterial and portal circulation. Overview of liver functions. Hepatic metabolism, protein synthesis, and storage function. Biotransformation of drugs and toxins. Liver's role in hemopoiesis and blood coagulation. Bile synthesis and excretion. Hepatic and cystic bile. Enterohepatic circulation. Hemoglobin breakdown: jaundice and its various forms. • Metabolism: Overview of the general chemical characteristics of carbohydrates, lipids, and proteins. Carbohydrate metabolism: food carbohydrates, digestion processes, absorption, and metabolic fate. Lipid metabolism: digestion, absorption, and metabolic fate. Protein metabolism: digestion, absorption, and metabolic fate. • Nutrition: Principles of dietetics. Energy requirements. Normal diet composition. Nutritional needs under special conditions (pregnancy, breastfeeding, childhood, old age, etc.). Mechanisms of hunger and satiety. **Ph regulation** • Control of intracellular and extracellular pH, buffer systems, acid-base balance disorders (respiratory and metabolic acidosis and alkalosis), and compensation mechanisms. Exercises: blood gas analysis (BGA) comprehension. **Thermoregulation** • Regulation of body temperature in humans, physiological and pathological variations in body temperature, thermal balance, thermogenesis, thermolysis, temperature regulation, responses to heat and cold. **Adaptations** • Adaptations to physical exercise. Body’s responses to physical exercise (cardiovascular, respiratory, plasma, muscular responses), pathologies induced by inactivity. Adaptations to high altitude, body’s responses to altitude,

	mountain sickness. Adaptations underwater. Hyperbaric gas physiology, hyperbaric syndrome. Effects of zero gravity. **Reproductive system** • **Female Reproductive System**: Function of female reproductive organs. Ovarian cycle. Ovary function. Puberty. Menopause. Functions of the fallopian tubes. Menstrual cycle. Estrous cycle. Chemistry and functions of ovarian steroid hormones. Physiology of sexual intercourse. Contraception. Extra-ovarian hormonal influences on the ovary. Pregnancy physiology. Lactation and its regulation. Brief notes on pathophysiology. • **Male Reproductive System**: Function of male reproductive organs. Spermatogenesis. Seminal pathways and accessory glands. Puberty. Physiology of sexual intercourse. Extra-testicular hormonal influences on the testicles. Actions of androgens and effects of testicular removal. Brief notes on pathophysiology.
Organ structure	• Alimentary system: mouth, appendages of the mouth, salivary glands, pharynx, esophagus, stomach, small intestine, large intestine liver extrahepatic ducts pancreas peritoneum • Urinary system: kidneys, urinary tract urinary bladder • Male genital system: testis, spermatic pathways, glands annexed to the spermatic pathways, external genitalia • Female genital system: ovary, uterine tubes, uterus, vagina, external genitalia
Biochemistry	• Heme biosynthesis and catabolism: related diseases • Blood biochemistry • Liver, muscle and kidney biochemistry: roles and interconnections • Nucleotide metabolism: "de novo" biosynthesis of pyrimidine nucleotides and its regulation. De novo biosynthesis of purine nucleotides and interconversion. Base recovery route and related diseases. Catabolism of purine nucleotides and acid uric; hyperuricemia (primary, secondary gout). • Signal transduction pathways.

Assessment methods

Subject	Assessment methods
Human physiology	The assessment of acquired knowledge is carried out through a written examination consisting of 30 questions: 16 on Human Physiology, 9 on Organ Structure, and 5 on Biochemistry, based on the respective curricula. Each question includes four statements, each of which must be marked as true or false, for a total of 120 true/false items. Each correct answer is awarded 1 point, each incorrect answer results in a deduction of 0.5 point, and unanswered items receive 0 points. To pass the examination, students must achieve a minimum score of 72/120, and a minimum of 50% in each subject, calculated as the algebraic sum of correct and incorrect answers. The overall score is then converted to a 30-point grading scale, with a maximum grade of 30/30 cum laude (with honours).
Organ structure	
Biochemistry	

Examples of common questions and/or exercises

Subject	Examples of common questions and/or exercises

Human physiology	In the heart: - β_1-adrenergic stimulation of autorhythmic cells increases Na^+ and Ca^{2+} influx (T/F) - muscarinic receptor stimulation of autorhythmic cells decreases the rate of depolarization (T/F) - β_1-adrenergic stimulation of working cardiomyocytes enhances calcium-induced calcium release (T/F) - the parasympathetic nervous system exerts a marked negative inotropic effect (T/F)
Organ structure	Lesser omentum: - consists of the hepatogastric ligament and hepatoduodenal ligament (T/F) - covers the small intestine and attaches to the transverse colon (T/F) - is formed by two layers of peritoneum stretched between the liver and other organs (T/F) - originates from the greater curvature of the stomach (T/F)
Biochemistry	AA Metabolism: - transamination involves the transfer of an amino group to an α-keto acid to produce glutamate (T/F) - pyridoxal-5'-phosphate (PLP), a derivative of Vitamin B6, is a required coenzyme for all transaminases (T/F) - all standard amino acids can undergo transamination reactions (T/F) - the Glutamate Dehydrogenase (GDH) reaction is a reversible mitochondrial process that can use either NAD+ or NADP+ as a coenzyme (T/F)

Reference texts

Subject	Textbooks
Human physiology	• Hall, J. E. Guyton and hall textbook of medical physiology. W B Saunders. Any additional educational material (slides, videos, handouts, etc.) will be distributed or indicated during the lessons.
Organ structure	• Anastasi et al., Human Anatomy, edi-ermes • Richard Drake A. Wayne Vogl Adam Mitchell. Gray's Anatomy for Students - Elsevier. • Susan Standring. Gray's Anatomy - The Anatomical Basis of Clinical Practice. - Elsevier. Any additional educational material (slides, videos, handouts, etc.) will be distributed or indicated during the lessons.Any additional educational material (slides, videos, handouts, etc.) will be distributed or indicated during the lessons.
Biochemistry	• Alisa Peet, Michael Lieberman- Marks' basic medical biochemistry fifth edition- Lippincott Williams and Wilkins • Devlin, T. M. Textbook of Biochemistry With Clinical Correlations, John Wiley and Sons. • David L. Nelson; Michael M. Cox. "Lehninger Principles of Biochemistry", W. H. Freeman & Co.

	• Voet D, Voet JG, Pratt CW. “Voet's Principles of Biochemistry, Global Edition”, Wiley. Any additional educational material (slides, videos, handouts, etc.) will be distributed or indicated during the lessons.

Course format

Subject	Course format
Human physiology	The teaching will primarily be conducted through in-person lectures with a blend of theory and practical exercises. In the event that teaching is delivered in a blended or remote mode, necessary adjustments may be introduced compared to what has been previously stated, in order to adhere to the planned program as outlined in the Syllabus.
Organ structure	
Biochemistry	

Attendance

Subject	Attendance
Human physiology	Mandatory attendance.
Organ structure	
Biochemistry	

Course schedule

Subject	Course schedule
Human physiology	Program topics from recommended textbooks and handouts provided by the teachers.
Organ structure	• Alimentary system-chapter 7 of Anastasi et al., Human Anatomy, edi-ermes) • Urinary system-chapter 9 of Anastasi et al., Human Anatomy, edi-ermes • Male genital system-chapter 10 of Anastasi et al., Human Anatomy, edi-ermes • Female genital system-chapter 11 of Anastasi et al., Human Anatomy, edi-ermes
Biochemistry	Program topics from recommended textbooks and handouts provided by the teachers.