



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Fisiologia Integrata:dalle Cellule Ai Sistemi

2021-1-F0901D044

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#### Aims

The course aims to provide students with an understanding of the physiological processes at cellular level and their integration finalized to the correct functioning of organs and systems. The information that will be provided are relevant to the preparation of a medical biotechnologist.

#### Contents

The course provides the student with the in-depth knowledge concerning the processes of integration between cell, tissue and organ, related to the human vital functions. It analyzes the mechanisms inherent to cardiovascular, respiratory, renal and endocrine system activity.

#### Detailed program

Cardiovascular system. Myocardium. Electrical activity of the heart: the cardiac action potential; automatism in the heart. Frequency adjustment in the heart. The heart as a pump. Control of cardiac output. Hemodynamics. The arterial system: arterial pressure and its control. Microcirculation and the lymphatic system.

Physiology of respiration. Lung as a gas exchanger. Spirometry: volumes and lung capacity. Ventilation. Dead space. Pulmonary mechanics. Mechanical thorax-lung coupling; origin of negative pleural pressure; pneumothorax. Pulmonary compliance. Surface tension and surfactant. Ventilation and perfusion. Pulmonary circulation. Factors that determine the non-uniformity of blood perfusion in the lung. Ventilation-perfusion ratio. Dissemination and transport of respiratory gases in the blood. Gaseous alveolus-capillary

exchanges. Lung diffusion capacity. Blood capacity for O<sub>2</sub>. Hemoglobin. Curve of dissociation of hemoglobin for O<sub>2</sub>. Influences of PCO<sub>2</sub>, pH and temperature on said curve. CO<sub>2</sub> transport in the blood. Blood capacity for CO<sub>2</sub>. Ventilation adjustment. Localization of respiratory centers. Respiratory response to CO<sub>2</sub>, pH, O<sub>2</sub>. Peripheral and central chemoreceptors. Respiratory regulation of acid-base balance. Blood buffers: bicarbonates, phosphates, proteins. Diagram of Davenport.

Renal function. Physiology of fluids and body osmolarity. Function structure of the kidneys. Glomerular filtration and renal blood flow. Renal transport mechanisms: reabsorption and secretion. Adjustment of the NaCl balance. Regulation of the balance of potassium. Renal regulation of the acid-base balance. Regulation of calcium and phosphate homeostasis.

The gastro-intestinal function. The perception of chemical senses: taste and smell. Gastrointestinal peptides: Gastrin, Cholecystinin, Somatostatin, and Ghrelin. Enteric nervous system and the autonomic nervous system. Cellular physiology of the smooth muscle of the gastrointestinal tract. Organization and electrophysiology of interstitial cells of Cajal. Motility and secretion in the esophagus, stomach and intestine. Salivary secretion and its regulation. Gastric secretion and its regulation. Physiology of pancreatic secretion and its regulation. Bile formation and enterohepatic circulation. Digestion and absorption of sugars Digestion and absorption of proteins. Digestion and absorption of fatty acids and formation of chylomicrons. Absorption of iron and calcium.

Introduction to the endocrine system: synthesis, transport and mechanisms of action of hormones classified by chemical structure, metabolism of hormones, positive and negative feedback mechanisms, levels of complexity of endocrine signaling, phenomena of signal integration between hormones. The hypothalamic-hypophysis axis: outline of hypothalamus and hypophysis anatomy, pituitary portal circulation, neurohypophysis secretions (chemical structure, functions, mechanisms that regulate the secretions), adenohypophysis secretions (chemical structure, functions, mechanisms that regulate the secretions). Thyroid and parathyroid glands: structure of the glands, synthesis of thyroid hormones, uptake of thyroglobulin, activation and inactivation of thyroid hormones, mechanisms that control the secretion, role of thyroid hormones, physiological functions of calcium and phosphate, mechanisms of control of plasma levels of calcium and phosphate (calcitonin, parathormone, calcitriol). The adrenal glands: structure of the glands, mechanisms that regulate the synthesis and metabolism of adrenocorticoid hormones, functions under control of adrenocorticoid hormones, catecholamines and their physiological actions. Endocrine pancreas: islands of Langerhans, functions of pancreatic somatostatin, pancreatic polypeptide and ghrelin, direction of metabolism and the ratio insulin/glucagon, stimuli that regulate the secretion of insulin and glucagon, mechanisms of insulin that cause plasma glucose lowering, effects of glucagon on the level of hepatic metabolism. Endocrinology and aging: pathophysiology of aging, theories on aging, alterations associated with the hypothalamic-hypophysis axis (somatopause, adrenaopause, menopause, andropause), thyroid (thyroid dysfunction), endocrine pancreas (beta cells).

## Prerequisites

Knowledge of the introductory courses indicated in the guidance of the degree course

## Teaching form

In the Covid-19 emergency period classes take place in mixed mode: asynchronous / synchronous videotaped lessons with some events, where possible, in presence

## **Textbook and teaching resource**

Some text book are suggested, stated that the student can use the text book that best allow him to form a solid knowledge of the subject, and that cannot be blocked by any of the texts listed below.

L. SHERWOOD, Fondamenti di Fisiologia Umana, Piccin

R. KLINKE, H.C. PAPE, A. KURTZ, S. SILBERNAGL, Fisiologia, EdiSES

A.C. GUYTON & J.E. HALL, Trattato di Fisiologia medica, Piccin

D.U. SILVERTHORN, Fisiologia, Un approccio integrato, Casa Editrice Ambrosiana

W.J. GERMAN & C.L. STANFIELD, Fisiologia Umana, EdiSES

## **Semester**

First Semester

## **Assessment method**

The exam consists in an written test. Open questions will be posed to the student in order to evaluate the general knowledge of the topics. Moreover, the student will be asked to answer to questions that require the analysis of a complex phenomenon, its rationalization and the application of specific physiology principles and to solve simple exercises. Finally, a clinical case may be presented which will require the analysis of the interconnections between different physiological variables in the light of the theoretical

paradigms.

**In the Covid-19 emergency period, the exams will be carried out electronically through the platforms made available by the University**

## **Office hours**

The professors receive the students by appointment agreed upon e-mail

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