

## ORGANIC AND FUNCTIONAL SYSTEMS III (ML0090)

### 1. language

English

### 2. course contents

Coordinator: Prof. SETTE CLAUDIO

Academic Year: 2022/2023

Year Course: 2

Semester: 2

CFU/UFC: 17,80

Modules and lecturers:

- ENDOCRINE SYSTEM: ANATOMY (ML0065) - 0.66 cfu - ssd BIO/16  
Prof. Chiara Naro
- ENDOCRINE SYSTEM: ANATOMY PRACTICALS (ML0066) - 0.34 cfu - ssd BIO/16  
Prof. Chiara Naro
- ENDOCRINE SYSTEM: EMBRYOLOGY (ML0069) - 0.4 cfu - ssd BIO/17  
Prof. Alessio D'Alessio
- ENDOCRINE SYSTEM: HISTOLOGY (ML0070) - 0.5 cfu - ssd BIO/17  
Prof. Alessio D'Alessio
- ENDOCRINE SYSTEM: HISTOLOGY PRACTICALS (ML0072) - 0.5 cfu - ssd BIO/17  
Prof. Maria Teresa Viscomi, Alessio D'Alessio
- ENDOCRINE SYSTEM: PHYSIOLOGY (ML0059) - 1 cfu - ssd BIO/09  
Prof. Maria Vittoria Podda
- NERVOUS SYSTEM GENERAL PSYCHOLOGY (ML0104) - 2 cfu - ssd M-PSI/01  
Prof. Paola Iannello, Alessandro Antonietti
- NERVOUS SYSTEM: ANATOMY (ML0097) - 3.2 cfu - ssd BIO/16  
Prof. Maria Concetta Geloso
- NERVOUS SYSTEM: ANATOMY PRACTICALS (ML0095) - 1.6 cfu - ssd BIO/16  
Prof. Alberto Campione
- NERVOUS SYSTEM: EMBRYOLOGY (ML0099) - 0.3 cfu - ssd BIO/17  
Prof. Maria Teresa Viscomi
- NERVOUS SYSTEM: HISTOLOGY (ML0101) - 0.54 cfu - ssd BIO/17  
Prof. Maria Teresa Viscomi
- NERVOUS SYSTEM: HISTOLOGY PRACTICALS (ML0102) - 0.16 cfu - ssd BIO/17  
Prof. Maria Teresa Viscomi
- NERVOUS SYSTEM: PHYSIOLOGY (ML0092) - 2.7 cfu - ssd BIO/09  
Prof. Guido Maria Filippi
- NERVOUS SYSTEM: PHYSIOLOGY PRACTICALS (ML0306) - 0.3 cfu - ssd BIO/09  
Prof. Domenica Donatella Li Puma
  
- REPRODUCTIVE SYSTEM: ANATOMY (ML0096) - 0.8 cfu - ssd BIO/16  
Prof. Claudio Sette
- REPRODUCTIVE SYSTEM: ANATOMY PRACTICALS (ML0098) - 0.2 cfu - ssd BIO/16  
Prof. Giuseppe Vizzielli
- REPRODUCTIVE SYSTEM: EMBRYOLOGY (ML0091) - 0.6 cfu - ssd BIO/17

Prof. Alessio D'Alessio

- REPRODUCTIVE SYSTEM: HISTOLOGY (ML0100) - 0.5 cfu - ssd BIO/17

Prof. Alessio D'Alessio

- REPRODUCTIVE SYSTEM: HISTOLOGY PRACTICALS (ML0103) - 0.5 cfu - ssd BIO/17

Prof. Maria Teresa Viscomi, Alessio D'Alessio

- REPRODUCTIVE SYSTEM: PHYSIOLOGY (ML0093) - 1 cfu - ssd BIO/09

Prof. Cristian Ripoli

### 3. bibliography

#### **Anatomy:**

Susan Standring: *Gray's anatomy, The Anatomical Basis of Clinical Practice, 41st edition, Elsevier.*

Frank H. Netter: *Atlas of Human Anatomy, Elsevier, 2010*

Vanderah TW and Gould D: *Nolte's The Human Brain: An Introduction to its Functional Anatomy, Elsevier; 7th Edition (June 5, 2015).*

#### **Histology and Embryology:**

##### **Embryology:**

Keith L. Moore, T.V.N. Persaud, Mark G. Torchia: *The Developing Human-Clinically Oriented Embryology, 11<sup>th</sup> Edition, Elsevier, 2019*

##### **Histology:**

Wojciech Pawlina: *Histology- A Text and Atlas with correlated cell and molecular biology, 8<sup>th</sup> Edition, Wolters Kluwers, 2019*

##### **Physiology:**

Walter F. Boron and Emile L. Boulpaep, *Medical Physiology: A Cellular and Molecular Approach, 2nd Edition, Saunders/Elsevier.*

Texts for consultation:

Guyton and Hall: *Textbook of Medical Physiology, 13th Edition, Elsevier, 2015.*

Dale Purves et al., *Neuroscience VIth edition, Oxford University Press.*

Eric R. Kandel, James H. Schwartz, Thomas M. Jessell: *Principles of Neural Science, 5th Edition, McGraw Hill.*

Berne & Levy, *Physiology VII edition (Section 8: The Endocrine and Reproductive Systems), Elsevier.*

##### **General Psychology:**

Griggs RA. *Psychology. A concise introduction, 3rd Edition, Worth Publishers, New York, 2012. (Chapters to be studied: 1 – 3 – 4 – 5 – 6 - 8)*

Antonietti A & Jannello P. (Eds.), *Psychological issues for medical education: From research to intervention*, PPM, CreateSpace Independent Publishing, New York, 2020. (The text is available through Amazon)

### 4. learning objectives

The course is aimed at giving the student a sound understanding of the structure, function, and development of Endocrine, Reproductive and Nervous Systems through a systemic approach integrating anatomy, embryology, histology and physiology. An introduction to the study of psychology is also part of the course (Module Nervous System). The specific aims of single modules are as follows.

The Anatomy module focuses on the gross and microscopic anatomy, topographical features,

*functional correlations and clinical implications of the various organs of the Endocrine, Reproductive and Nervous Systems. Practical activities will be carried out to address the identification of macroscopic and microscopic features of different organs through radiologic anatomy and examination of representative histologic samples. In addition, brain dissections will be shown and computer-assisted didactic facilities will be made available for students' self-training.*

*The Histology and Embryology modules aim to provide principles of development, illustrate the histological structure of Endocrine, Nervous and Reproductive Systems and establish clinical correlates. Students will have the opportunity to observe and analyze tissue preparations under the light microscope in order to learn about normal histological aspects, essential to recognize abnormal diseased structures.*

*The Physiology modules aim at providing a broad understanding of the functional role of endocrine, reproductive and nervous systems, focusing on the mechanisms underlying their functions and the interaction among these systems. In particular, the neuro-endocrine control of the reproductive system will be discussed. The modules will also provide an integrated view of how endocrine and nervous systems work as regulatory systems allowing the body to respond properly to inputs from the external and internal environments. Examples of the underlying physiology behind common clinical conditions will be provided, to prepare students for their future role as medical doctors. Laboratory and class practical lessons will promote the student capability of applying knowledge and understanding of the physiological parameters whose evaluation is relevant for medical assessment of patients.*

*The Psychology course aims to introduce students to the study of the main fields, theories, and research methods of psychology and to apply them to a set of topics which are relevant to medicine. The student is expected to improve his/her understanding of how psychology functions as a science and to appreciate possible contributions for medical practice coming from psychology, with the goal to realize how physician's and patient's behaviors are modulated by psychological mechanisms.*

*At the end of the integrated course, the student must demonstrate that he has accomplished the following objectives:*

*Knowledge and understanding abilities*

*To have acquired the knowledge of the different levels of organization of Endocrine, Reproductive and Nervous Systems, at both macroscopic and microscopic levels;*

*To have acquired the knowledge of cellular functions and physiological mechanisms for the implicated tissues and organs;*

*To know and understand the basic embryological mechanisms of Endocrine, Reproductive and Nervous System development.*

*To know and understand the histological structure of the organs of Endocrine, Nervous and Reproductive Systems.*

*To have acquired the knowledge of Endocrine, Reproductive and Nervous System functions.*

*To know the main contributions of psychology to the understanding of human behavior.*

### Applied knowledge and understanding skills

*To have acquired the knowledge and understanding of the structural and functional features of the systems studied;*

*To demonstrate technical knowledge of the methods applied in the different disciplines of the course to acquire information on the functional and pathological features of the systems studied;*

*To understand and critically evaluate the clinical relevance of the acquired knowledge about endocrine, reproductive and nervous systems, with reference to basic implications in pathology, as well as diagnostic and therapeutic applications.*

*To demonstrate practical skills in microscopic examination of Endocrine, Nervous and Reproductive System tissue specimens, recognize normal structures and make a differential diagnosis.*

*To demonstrate practical skills in the assessment of physiological reflexes and visual acuity.*

*To apply psychological notions and theories to specific situations concerning health.*

### Personal judgement

*The student must properly integrate the knowledge and skills learned to develop autonomous abilities to identify the fundamental structures of endocrine, reproductive and nervous systems, and the associated physiological and psychological mechanisms, relevant for the application in the medical field.*

### Communication skills

*The student should be capable of communicating the acquired scientific knowledge and applied know-how, in a clear and unambiguously way, using an appropriate technical language.*

### Learning ability –

*The student should have acquired competence to keep up-to-date and expand her/his knowledge by autonomously consulting reference textbooks, scientific literature and databases.*

## 5. PREREQUISITES

*In order to better understand the topics of the course and to formally register for the exam session, students must have attended and passed the exams of the first year.*

## 6. teaching methods

*The course is organized into lectures and practical sessions covering the topics included in the teaching modules (Endocrine, Reproductive, Nervous Systems) to provide specialized elements of Anatomy, Histology/Embryology, Physiology and General Psychology. The lessons are supported by visual aids (slides, animated movies, etc.) that stimulate the interest of learners and help the teachers to explain the concepts easily. There are two fully equipped microscopy laboratories and*

*the students will have individual and personalized access to optic microscopes and histological specimens for practical training under teacher's supervision, and in subsequent self-learning sessions that precede the exams. Computer-assisted facilities will also be made available for students' self-training. The students will have access to neurophysiology research laboratories to gain insight on preclinical approaches to study the nervous system in experimental models. Laboratory and class practical lessons promote the student's capability of applying knowledge and understanding; work in small groups stimulates discussions and the development of communication skills. In case of inability to carry out practical training with a microscope (e.g. due to Covid-19 prevention measures), online training sessions will be organized for the analysis of histological and anatomical images.*

#### Knowledge and understanding

*During frontal lessons, the teachers will illustrate the main aspects of Endocrine, Reproductive and Nervous Systems, from the viewpoint of Anatomy, Histology, Embryology, Physiology and Psychology, underscoring the connections between these disciplines and the relevance of this knowledge for medicine and surgery.*

#### Applying knowledge and understanding

*During frontal lessons and sessions of practical training the students are stimulated to actively interact with the teacher, by asking questions aimed at clarification of specific points but also at expanding knowledge beyond the essential contents, and in perspective to its application for clinical medicine. Students may be further challenged during classes with trial tests or problem-solving questions, for training in preparation to the exam. The elaboration of possible intervention programs aimed at improving the quality of medical care thanks to psychological principles will be also requested.*

Making judgements: *During the practical training in microscopic and macroscopic analyses of tissues and organs, the critical attitude of the student will be stimulated by asking to identify the most important elements in the specimen/image and to underscore uncommon findings deserving further study. Personal opinions, supported by arguments based on the acquired notions, about the issues addressed in the Psychology module will be stimulated as well.*

Communication skills: *Students are stimulated to ask and to answer questions and to interact with the teacher during both frontal lessons and practical training. If difficulty in scientific communication or technical language is noticed, the teacher will suggest the appropriate wording or style to clearly express concepts and data, in order to promote the acquisition of qualifying communication skills.*

Learning skills: *While theoretical lessons are focused on the fundamental aspects of the course contents, the students are expected to develop and expand this knowledge by studying on the suggested textbooks and by consulting additional references, such as for*

example interactive iconography or animated movies, available online. At any phase of their learning process, the students may request to the teacher further clarification on specific aspects or additional references for expanding basic knowledge.

#### 7. other information

*During exams, any portable electronic device, including mobile phones, must be switched off and put over the desk. Upon request by the students and consent by the teachers, internships to follow practical scientific work performed in the laboratories is feasible.*

#### 8. methods for verifying learning and for evaluation

*The exam is composed by a written examination based on a multiple-choice questionnaire regarding all modules; for each question, a single correct answer is possible. The number of questions for each Discipline is aimed at covering the program of the course. In order to pass the written test, the student has to answer correctly to at least 60% of the questions of discipline. The score obtained in the written test will be initially calculated for each of the disciplines for which the threshold is passed, ranging from 18 to 30/30. Maximum score (30 cum laude) may be assigned for flawless tests. For Histology, in addition to the written test, an oral part will verify the acquisition of practical abilities in the use of the light microscope to recognize, describe and discuss histological features of tissue specimens from Endocrine, Reproductive and Nervous Systems. In case of inability to verify practical skills with a microscope (e.g. due to Covid-19 prevention measures), the student's capacity to analyze histological images will be assessed. The score assigned after this part will be averaged with the Histology/Embryology score obtained in the written test.*

*The global and final score of the exam will be calculated by weighted average of the partial scores obtained for the various integrated modules (Anatomy, Histology/Embryology, and Physiology), taking in account the UFCs assigned to each discipline. The score will be rounded up to the nearest integer, in a range between 18 and 30 with honors (cum laude).*

##### Knowledge and understanding

*A multiple-choice questionnaire will allow to verify the acquired knowledge about Endocrine, Reproductive and Nervous Systems, under the various viewpoints of Anatomy, Histology, Embryology, Physiology and Psychology. For Histology, the oral part is aimed at assessing the acquired practical skills in microscopic examination of tissue specimens that are representative of these systems and the ability of making a differential diagnosis.*

##### Applying knowledge and understanding

*Some of the questions in the written test, based on exemplified clinical cases, will verify the ability of students to apply the knowledge acquired in the course to clinical practice. In the oral exam, students are expected to use appropriate technical language the description of histological structures and features.*

##### Making judgements

*The ability to choose the correct answer in a pool of options will verify the ability of the student to make correct judgements.*

##### Communication skills:

*The students are invited to ask questions and to provide answers during both frontal lessons and practical sessions. The teacher will help the students to learn and apply a correct technical language to describe the topics of the courses discussed in the class.*

## Learning skills

*Both the multiple-choice questionnaire and the discussions in class will allow the students to demonstrate the acquired knowledge, ranging from fundamental information to specific details revealing in-depth learning skills.*

### 9. program

#### **Endocrine system:**

##### **Anatomy**

*Overview of the endocrine system and hormones. Hypothalamus: gross anatomy, microscopic anatomy, blood supply. Pituitary gland: adenohypophysis and neurohypophysis; gross anatomy, topography, microscopic anatomy, blood supply. Hypothalamic-pituitary axis. Pineal Body: gross anatomy, topography, microscopic anatomy. Thyroid gland: gross anatomy, topography, blood supply, lymphatic drainage. Parathyroid glands: gross anatomy, anatomical relations, blood supply, lymphatic drainage. Adrenal glands: topography, anatomical relations, gross anatomy, blood supply, lymphatic drainage. Pancreas: Islets of Langerhans: topography and anatomical organization. Thymus: gross anatomy, topography, anatomical relations.*

*Practical training: Examination of histological sections of pituitary gland stained with markers of the different cellular types.*

##### **Embryology**

*Development of endocrine glands. Development of hypophysis, thyroid, parathyroid and adrenal glands. Fetal-placental Unit. Ectopic thyroid gland. Congenital Hypothyroidism. Thyroglossal duct cysts and sinuses. Ectopic parathyroid glands. Abnormal number of parathyroid glands. Congenital adrenal hyperplasia and adrenogenital syndrome.*

##### **Histology**

*Architecture of thyroid, parathyroid and adrenal glands. Abnormal thyroid function. Chromaffin cells and Pheochromocytoma. Diffuse Neuroendocrine System. Principles of endocrine diseases.*

*Practical training: By studying histological sections of thyroid, parathyroid and adrenal glands, students learn to recognize and analyse the different tissue and organ components.*

##### **Physiology**

*Principles of endocrine function. The hypothalamopituitary axis: anterior and posterior pituitary hormones. Endocrine regulation of growth and body mass: growth hormone and Insulin-like growth factor 1. The thyroid gland. The adrenal gland: adrenal cortex and adrenal medulla hormones. Regulation of calcium and phosphate balance: parathyroid hormone and vitamin D.*

#### **Reproductive system:**

##### **Anatomy**

*Female genital tract. Internal genitalia. Ovary: ovarian fossa, topography, anatomical relations, ovarian ligaments; gross anatomy and structure, blood supply, lymphatic drainage. Fallopian tube: topography, anatomical relations, mesosalpinx; gross anatomy and structure, blood supply, lymphatic drainage. Uterus: topography, anatomical relations, ligaments, gross anatomy, structure, blood supply, lymphatic drainage. Vagina: topography, anatomical relations; gross anatomy, structure, blood supply, lymphatic drainage. External genitalia: vulva; mons pubis, clitoris, labia majora and labia minora. Structural modifications during pregnancy and delivery. Male genital tract. Testes: gross anatomy, structure and coverings; testis descent. The epididymis: blood supply, lymphatic drainage. Spermatic cord, vas deferens: structure, layers and anatomical relations. Seminal vesicles and ejaculatory ducts: structure, position, anatomical relations. Prostate gland:*

topography, anatomical relations, gross anatomy, structure, blood supply, lymphatic drainage. Penis: gross anatomy, corpora cavernosa and corpus spongiosum, blood supply, lymphatic drainage. Bulbourethral glands. Pelvic floor anatomy: endopelvic fascia, pelvic diaphragm, urogenital diaphragm. Perineum. Clinical correlates: anatomical variants of uterine positions and morphology, ovarian torsion, testicular torsion, varicocele and hydrocele.

Practical training: Interactive learning lessons on topographic anatomy of the reproductive system

## **Embryology**

Development of genital system. Development of gonads. Development of male and female genital ducts and glands. Development of vagina. Development of male and female external genitalia. Testicular and ovarian descent. Androgen insensitivity syndrome. Mixed gonadal dysgenesis. Hypospadias. Epispadias. Anomalies of uterine tubes, uterus, and vagina. Ectopic testis.

## **Histology**

Structure of the testis. Spermatogenesis. Seminiferous tubules. Intratesticular ducts. Excurrent duct system. Accessory glands. Semen. Factors affecting spermatogenesis. Benign prostate hypertrophy and cancer of the prostate. Ovarian structure. Ovarian cycle. Hormonal regulation of the ovarian cycle. Ovulation. Uterine tubes. Uterus. Menstrual cycle. Mammary glands. Polycystic ovarian disease. Cytologic Pap smears. Papilloma virus infections. Lactation and Infertility.

Practical Training: By studying histological sections of the organs of the Reproductive system, the students will learn how to recognize and analyze the different tissue components and their organization and to make a differential diagnosis.

## **Physiology**

Functional organization of the male reproductive system; the male hypothalamic-pituitary-gonadal axis. Physiological events of male puberty. Physiological adult male gonad function. Functional organization of the female reproductive system. Physiological events of the female puberty. The female hypothalamic-pituitary-gonadal axis. Female menstrual cycle in ovary, tube, uterus; hormonal control of the cycle and correlation between hormonal levels and organ cyclical changes; menopause.

## **Nervous System:**

### **Anatomy**

Gross anatomy and general organization of the Central Nervous System: meninges; brain ventricles and cerebrospinal fluid. Cerebrum: cerebral hemispheres, central white matter. Basal Ganglia; Diencephalon: epithalamus, thalamus and hypothalamus. Brain Stem: mesencephalon, pons and medulla oblongata. Reticular Formation. Cerebellum and cerebellar nuclei. Spinal cord: general organization. Sensory systems. Somatic sensory systems: medial lemniscal system; spinothalamic tract. Visual system: visual pathways, photo-motor reflex. Auditory system. Vestibular system. Olfactory system. Taste pathway. Motor systems: Somatic motor system (Cortico-spinal tract, upper and lower motor neurons, reticulospinal tract, rubrospinal tract, vestibulospinal tract, tectospinal tract). Cerebellar organization and cerebellar afferent and efferent pathways. Basal ganglia and related nuclei: direct and indirect pathways. Cerebral cortex, general organization: principal cells and interneurons; laminar and columnar organization; functional areas of cerebral cortex. Dorsal thalamus and thalamo-cortical connections. Hypothalamus and limbic system and related circuitry. Blood supply of the brain. Peripheral nervous system: general organization. Cervical plexus and its main terminal branches; Brachial plexus and principal nerves of the upper limb; lumbar plexus, sacral plexus and principal nerves of the lower limb. General organization and functions of the autonomic nervous system; sympathetic and parasympathetic nervous system. Cranial nerves (I-XII): nuclei and peripheral course.

Practical training: Interactive learning lessons with the aid of the Anatomage Table for 3D anatomy visualization of the gross anatomy of the brain and peripheral course of cranial and spinal nerves



## **Embryology**

*Early neural development. Origin of nerve tissue cells. Development of brain and of spinal cord: grey and white matter. Late neural development. Brain modelling: neuronal migration, axonal growth, synaptogenesis, cell death, and myelination. Birth defects of brain. Development of peripheral nervous system and of autonomic nervous system.*

## **Histology**

*Composition of nerve tissue. The neuron: cell body, dendrites and axons. Axonal transport system. Synapses. The neuroglia: Central and Peripheral neuroglia. Schwann cells and oligodendrocytes and the myelin sheath. Cellular bases of neurodegenerative diseases. Response of central and peripheral neurons to injury. Glial scar formation in response to injury.*

*Practical Training: by studying histological sections of nerve tissue stained with different dyes, Students learn to recognize and analyze the different tissue components and their organization.*

## **Physiology**

*Sensory transduction, concept of sensory line. Chemoreception: taste, smell. Visual transduction. Vestibular and auditory transduction: hair cells. Somatic sensory receptors: touch modality, proprioception and pain. Autonomic nervous system. Elements of neural circuits and spinal reflexes. Cardiovascular and breathing control. Elements of cortical organization. Motor control. Elements of neural circuits and rhythmic patterns. Cerebrospinal fluid.*

*Practical training: visual acuity and visual field tests; reflex testing.*

## **Psychology**

- a) *Basic notions: The science of psychology: aims, relevance to medical education, theoretical perspectives, methods of psychological research; Psychological functions: sensation and perception, learning, memory, thinking and intelligence, personality and individual differences.*
- b) *Advanced and specific, contextualized notions: naïve conceptions about health; psychological factors in medical care; empowerment of patient's skills; medical decision making.*