Human Physiology (20403 - 20338)

Qualification/course: Bachelor’s Degrees in Medicine and in Human Biology
Year: 2
Term: 2
Number of ECTS credits: 8 credits
Student study time: 8 credits in total, which consist of 88 hours attending course activities and 112 hours of individual work. The face-to-face activities are divided into 40 hours of lectures, 16 hours of seminars and 32 hours of practical sessions.
Course language(s): Catalan / Spanish
Teaching staff: The subject coordinator is Dr. Francisco J. Muñoz (Tenured Assistant Professor, UPF). The lecturers are Drs. Miguel A. Valverde (Full Professor, UPF), José M. Fernández (Tenured Assistant Professor, UPF), Rubén Vicente (Lecturer, UPF), Mariano Sentí (Tenured Assistant Professor, UPF), Joaquim Gea (Full Professor, UPF), Jaume Puig (Assistant Professor, UPF), and Anna Garcia-Elias (Visiting Professor), who will be teaching the theoretical and practical parts.

1. Presentation of the course

This subject concentrates on the study of the function and regulation of the different systems governing the functioning of the human body: cardiovascular system, respiratory system, blood tissue, digestive system, hydrosaline metabolism and renal function, hormone physiology and the physiology of reproduction.

2. Competences to be achieved

1. To learn about the morphology, structure and function of the circulatory system.
2. To learn about the morphology, structure and function of the respiratory system.
3. To learn about the morphology, structure and function of the blood.
4. To learn about the morphology, structure and function of the digestive system.
5. To learn about the morphology, structure and function of the excretory system.
6. To learn about the morphology, structure and function of the endocrine system.
7. To learn about the morphology, structure and function of the reproductive system.

3. Contents

3.1. Theory

Each topic is given in 1-hour lectures.

1. Cardiovascular system (Dr. M. Sentí)
Topic 1. Properties of the cardiac muscle
Automatism: origin of the heartbeat in pacemakers. Cardiac impulse conduction.
Excitability of the heart. Interpretation of the electrocardiogram (ECG). Extrasystoles (premature ventricular contractions). Contractility. Length-tension relationship in the cardiac muscle. Vegetative control of the cardiac function.

Topic 2. The heart as a pump
The cardiac cycle. Cardiac cavities and valves. Measurement of the pressure and volume of the cardiac cavities and analysis of changes during the cardiac cycle. Temporary correlations with the ECG. Valve function: heart sounds. Changes in the cardiac cycle caused by changes in cardiac frequency. Control of cardiac frequency. Intrinsic regulation: Frank-Starling law, regulation by frequency and postextrasystolic potentiation. Extrinsic nervous and hormonal regulation.

Topic 3. General organization of the circulatory system
Systemic circulation and pulmonary circulation. Functional characteristics of each of the sections of the circulatory system. Pressure, volume and speed of the blood in each section.

Topic 4. Haemodynamics

Topic 5. Circulation in large arteries

Topic 6. Capillary circulation

Topic 7. Venous circulation
General characteristics. Central venous pressure and peripheral venous pressure: measurement and factors on which they depend. General factors which aid venous circulation.

Topic 8. Peripheral circulation and its control
Control of tissue perfusion: local factors and auto-regulation of the flow. Blood pressure control as a determining factor in tissue perfusion: Central role of the baroreceptor reflex.

Topic 9. Control of cardiac flowrate and coupling between the heart and the veins
Methods of measurement, normal values and physiological variations of the cardiac flowrate. Factors determining the cardiac flowrate. Cardiac factors: cardiac function curves. Vascular factors: vascular function curves. Analysis of the modifications of the cardiac output per minute occurring in different circumstances.

Topic 10. Special circulatory systems

II. Respiratory system (Dr. J. Gea)

Topic 11. General functions of the respiratory system

Topic 12. Static mechanical properties of the lung and thorax

Topic 13. Dynamic mechanical properties of the lung and thorax

Topic 14. Alveolar ventilation

Topic 15. Gas exchange in the lungs

Topic 16. Ventilation-perfusion relationship
Measurement of alterations in the ventilation/perfusion ratio. Calculation of the

Topic 17. Transport of oxygen and carbon dioxide through the blood

Topic 18. Control of pulmonary ventilation

III. Blood Physiology (Dr. M. Sentí)


Topic 20. Antigenic properties of the erythrocyte

IV. Digestive system (Dr. F. J. Muñoz)

Topic 21. Digestive motility I

Topic 22. Digestive motility II

Topic 23. Digestive secretion I
Topic 24. Digestive secretion II

Topic 25. Digestive absorption
Digestion and absorption of carbohydrates, lipids, proteins, vitamins, water and electrolytes.

V. Hydrosaline metabolism and renal function (Dr. R. Vicente)

Topic 26. Volume and composition of body fluids

Topic 27. Glomerular function

Topic 28. Tubular function: Reabsorption

Topic 29. Tubular function: Secretion
Active and passive secretion. Topography of secretion. Urine concentration: proximal tubule, loop of Henle, descendant and ascendant segments, distal and collector tubule.

Topic 30. Renal regulation of acid-base equilibrium

VI. Hormone physiology (Dr. J. Puig)

Topic 31. Introduction to endocrine physiology
Definition of hormone and receptor. Types of hormone and receptor. General forms of hormonal synthesis, secretion, action and regulation. Endocrine glands. Endocrine, paracrine and autocrine systems. Hormone transport and degradation.

Topic 32. Hypophysis and hypothalamus
Topic 33. Thyroid gland
Metabolism of iodine. Thyroid hormones. Synthesis, transport and actions. Regulation and functional exploration of the thyroid.

Topic 34. Hormones related to the bone metabolism (calcium and phosphorus)

Topic 35. Endocrine pancreas and other hormones of the gastrointestinal tract

Topic 36. Adrenal gland hormones

Topic 37. Adrenal gland hormones II

VII. Reproductive Physiology (Dr. J. Puig)

Topic 38. Reproductive physiology II

Topic 39. Reproductive physiology I

Topic 40. Fecundation and gestation
The placenta as an endocrine gland: betaHCG and placental lactogen. Hormonal, metabolic,
respiratory and cardiovascular particularities of the pregnant woman. Physiology of childbirth.

3.2. Practical sessions

These are held in groups of 15 students per session. There are different numbers of sub-groups depending on the types of practical session.

Practical Session 1. Electrocardiography I (Dr. R. Vicente and Dr. Anna García-Elías) Interpretation of the electrocardiogram. The electrical activity of the heart in relation to the mechanical activity that occurs during the cardiac cycle. Observation of changes in heart rhythm associated with changes in posture. Analysis and interpretation of results. (4 hours). This practical session is held with 4 sub-groups of 3-4 students each.

Practical Session 2. Electrocardiography II (Dr. R. Vicente and Dr. Anna García-Elías) Simultaneous recordings of precordial and arterial pulse readings. Use of the plethysmograph to evaluate changes in peripheral blood pressure. Analysis and interpretation of results. (4 hours). This practical session is held with 4 sub-groups of 3-4 students each.

Practical Session 3. Respiratory cycle (Dr. R. Vicente and Dr. Anna García-Elías) Recording of pulmonary ventilation using a pneumograph and ventilated air flow transducers. Analysis and interpretation of results. (4 hours). This practical session is held with 4 sub-groups of 3-4 students each.

Practical Session 4. Pulmonary flows (Dr. R. Vicente and Dr. Anna García-Elías) Determination of forced vital capacity, forced expiratory volume and maximal voluntary ventilation. Analysis and interpretation of results. (4 hours). This practical session is held with 4 sub-groups of 3-4 students each.

Practical Session 5. Blood groups (Dr. M. Sentí) Taking blood samples for processing and determining blood groups and Rh factor. Analysis and interpretation of results. (2 hours). This practical session is held with 4 sub-groups of 3-4 students each.

Practical Session 6. Galvanic skin response and the polygraph (Dr. Anna García-Elías) A study will be conducted of the bio-electrical response of the skin, which changes in accordance with levels of perspiration (sympathetic control). The polygraph (lie detector) associates the recording of a galvanic response with other physiological variables such as respiratory and cardiac frequencies, the control of which depends on the vegetative system. Analysis and interpretation of results. (4 hours). This practical session is held with 4 sub-groups of 3-4 students each.

Practical Session 7. Vascular damage (Dr. F. J. Muñoz) This session studies an element of vascular damage caused by atherogenic processes. It consists of in vitro induction of damage through nitrination in plasma proteins (albumin) with a peroxynitrite donor and subsequent evaluation of the protein nitration by measuring the
absorption of nitrotyrosines at 412 nm. Analysis and interpretation of results. (4 hours). This practical session is held with 8 sub-groups of 2 students each.

Practical Session 8. Renal function (Dr. R. Vicente)
Renal function simulation using computer models. Analysis and interpretation of results. (4 hours). This practical session is held with 4 sub-groups of 3-4 students each.

Practical Session 9. Assessment of the practical knowledge acquired in the subject (2 hours). (Dr. R. Vicente)

3.3. Seminars

The seminars are held in groups of 30 students and involve the discussion of real cases in sub-groups of 6-8 students. The aim is to aid the revision of the main physiological concepts and demonstrate, in a practical manner, that pathology is essentially the result of the alteration of physiology. The ability to discuss the cases will be assessed in Seminar 8, which will consist of dealing with a practical problem and two questions, which are to be answered individually. Each seminar lasts for two hours.

Seminar 1. The heart as a pump (Dr. M. A. Valverde)
Seminar 2. The arterial system (Dr. J. M. Fernández)
Seminar 3. Alterations in ventilation (Dr. J. Gea)
Seminar 4. Exchange of gases (Dr. J. Gea)
Seminar 5. Osmolality and ion regulation of the kidney (Dr. R. Vicente)
Seminar 6. Hypersecretion of the growth hormone and of the thyroid hormone (Dr. F. J. Muñoz)
Seminar 7. Hypersecretion of cortisol (Dr. F. J. Muñoz)
Seminar 8. Assessment by problem-solving with notes and books (Dr. Anna García-Elías)

4. Assessment

The assessment of academic performance is done in the following manner (out of a total of 10 points):

- Multiple-choice test based on the theoretical topics covered and will count as a maximum of 2.5 points out of the total mark.

- Theoretical written test with two short questions for each of the topics studied. One short question is to be answered per topic, chosen from two options, and written on one side of A4 paper (maximum). This will count as a maximum of 5 points of the total mark.

- Practical test: assessment of the knowledge acquired from the content of the practical sessions. This will count as a maximum of 1.25 point of the total mark.

- Seminar Test: consisting of problem solving with notes and books. This will count as a maximum of 1.25 point of the total mark.
- Formative assessment: the Faculty of Life and Health Sciences, in keeping with its programme of continuous assessment, holds an examination to measure progress halfway through the term (topics 1 to 9). Up to 0.5 points will be added to the final mark.

*July special evaluation:* for those who had not passed the June exam there is a second chance at the end of July consisting of multiple-choice tests and theoretical written tests with one short question for each of the topics studied. This will count as a maximum of 7.5 points of the total mark. The knowledge evaluated along the trimester (formative, practical and seminar tests) will be not recovered in this special exam.

**REQUIREMENTS**

- A good level of English is recommended to follow this subject.
- Notes dealing with each topic, and programmes for practical sessions and seminars, are available in the Aula Global from the start of the academic year.
- Attendance at practical sessions is obligatory, and official justification must be provided for any absences.
- Students for seminars and practical sessions may not change group unless the changes (which must be consistent when exchanged with another student) have been approved beforehand by the Faculty Secretary's office.
- Students must bring the session or seminar plan to all practical sessions and seminars.
- Students must wear lab-coats when participating in the practical sessions.
- Those repeating the examination will not be required to repeat the practical sessions and seminars, but will have to carry out a new examination concerning practical work and seminars.

**5. Bibliography and teaching resources**

**Bibliography recommended**


Complementary Bibliography


