### MODULE CONTENT YEAR TERM CREDITS TYPE

| BASIC COMMON KNOWLEDGE | HUMAN AND CELL PHYSIOLOGY | 2nd | 2nd | 6 ECTS | Obligatory |

### LECTURER(S)

- Jesús Rodríguez Huertas (T*; P*)
- Julio J. Ochoa Herrera (T*; P*)
- Jorge Moreno Fernández (T*; P*)
- Maria García Burgos (T*; P*)
- Alfonso Varela López (T*)
- Marta de la Flor Alemany (P*)

(T*: Theory; P*: Practice)

#### Postal address, telephone nº, e-mail address

<table>
<thead>
<tr>
<th>Jesus Rodriguez Huertas</th>
<th><a href="mailto:jjoh@ugr.es">jjoh@ugr.es</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Julio J. Ochoa Herrera</td>
<td><a href="mailto:jhuertas@ugr.es">jhuertas@ugr.es</a></td>
</tr>
<tr>
<td>Jorge Moreno Fernandez</td>
<td>Dpt. Physiology, Faculty of Physical Activity and Sport Science</td>
</tr>
<tr>
<td>Maria Garcia Burgos</td>
<td>Institute of Nutrition and Food Technology, Centre for Biomedical Research, 1st floor. Health Sciences Technology Park, Avda. del Conocimiento s/n, Armilla. 958241000 ext. 20319</td>
</tr>
<tr>
<td>Alfonso Varela Lopez</td>
<td><a href="mailto:jjoh@ugr.es">jjoh@ugr.es</a></td>
</tr>
<tr>
<td>Marta de la Flor Alemany</td>
<td>Dpt. Physiology, Faculty of Physical Activity and Sport Science</td>
</tr>
</tbody>
</table>

### Degree within which the subject is taught

Degree in Physical Activity and Sport Science

### Tutoring

http://www.ugr.es/~fisiougr/tutorias.php

### Prerequisites and/or Recommendations

Prerequisites: those necessary to access to the degree, related with the level of formation that the student must acquire to accede to the University.

Recommendations: to have previous basic knowledge (background knowledge of Chemistry, Anatomy and Histology, Biochemistry, Metabolism.

A good standard of English and computer skills are also required.

### Brief Account of the Subject Programme (According to the Degree)

The programme has a high degree of coherence and integration and cover a diverse range of topics, while reflecting particular strengths within the biological and life sciences and there is a clear coherence between...
the different modules. Physiology is a study of the normal functions of cells, organs and systems of the living body, the mechanisms by which they are achieved and the regulation of functional activities to maintain the homeostasis, therefore the programme has been divided into thematic units just for didactic purposes, but during the course we will integrate all the body systems defining their links to maintain the homeostasis.

1. Program Theory
   Thematic Unit I: Introduction and cell Physiology
   Thematic Unit II: Nervous System
   Thematic Unit III: Body Fluids and Blood.
   Thematic Unit IV: Endocrine System
   Thematic Unit V: Cardiovascular System
   Thematic Unit VI: Respiratory System
   Thematic Unit VII: Renal System
   Thematic Unit VIII: Digestive System
   Thematic Unit IX: Reproductive System

2. Program Practic
   Practice 1. Detailed functional study of different organs and body systems models.
   Practice 2. Blood cell count and morphology by mean of the optical microscope.
   Practice 3. Determination of hemoglobin and hematocrit. Automatic counting of leukocytes and erythrocytes
   Practice 5. Respiratory system assessment by mean of spirometry

GENERAL AND PARTICULAR ABILITIES

Physiology is a study of the normal functions of cells, organs and systems of the living body, the mechanisms by which they are achieved and the regulation of functional activities. A firm grasp of its principles is essential not only for the study of successive courses, but also for students’ future professional career after graduation. Selection of the teaching material will be in accordance with the necessity of professional education and will be laid emphasis on basic theories and knowledge of physiology as well as on the training of basic techniques. Attention will also be paid to promote the ability of scientific thinking of the students. In order to foster the students’ ability of studying physiology, we conduct our teaching with several methods, such as self-study, exhibition in small groups and tutoring instead of to be given only by lecturer in the classroom. The lifelong learning to obtain more and better competences requires new pedagogical practices and the emergence of new scenarios for the students in where multimedia shall play a predominant role in our programme. Therefore, multimedia resources will be using our methodological teaching-learning process in the classroom. Cooperative learning networks will be built and innovative teaching-learning strategies will be used to complement the traditional classes.

OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)

General Disciplinary Competencies:
1. Apply the biological, mechanical, behavioral and social principles to the different professional exits: Training, Education, Health, Management and Recreation.
Specific Disciplinary Competences:
Education sector
1. To design, develop and evaluate the teaching / learning processes related to physical activity and sport with attention to the individual and contextual characteristics of the people.

Scope Sports Training:
2. Apply the physiological, biomechanical, behavioral and social principles, during the direction of the sports training.

DETAILED SUBJECT SYLLABUS

We will use several multimedia instruments during the course to enhance the teaching-learning process of the student. This programme has been designed taking into account the integration concept and cover a diverse range of physiological topics, with a clear coherence between the different modules. Physiology is a study of the normal functions of cells, organs and systems of the living body, the mechanisms by which they are achieved and the regulation of functional activities to maintain the homeostasis, therefore the programme has been divided into thematic unit just for didactic purposes, although during the course we will integrate all the body systems, to understand better how they maintain a stable, constant condition.

Program theory (with aims and time schedule)

THEMATIC UNIT I: INTRODUCTION AND CELL PHYSIOLOGY

Subject 1. - Introduction to Physiology (0,5h)
Define the concepts of physiology, internal medium and homeostasis.

Subject 2. - Functional organization of the cell (Plasma membrane). Transport across the plasma membrane (1h)
Understanding the functional organization of the cell. Describe the functions of the plasma membrane. Knowing the ionic composition of the intracellular and extracellular fluids. Differentiate processes of endocytosis (pinocytosis, phagocytosis) and exocytosis. Understanding the mechanisms of passive transport: simple diffusion and facilitated diffusion. Knowing the characteristics and regulation of the various kinds of ion channels. Differentiate primary and secondary active transport. Know the characteristics and properties of the ion pumps.

Knowing paracellular transport

Subject 3. - Resting membrane potential and action potential. Excitability (1,5h)
Describe and explain the resting membrane potential and ionic bases. Describe the local potential and ion channels involved. Describe and explain the phases, properties and ionic basis of the action potential. Knowing the excitability changes along the action potential. Describe the action potential conduction and the effect of myelin

THEMATIC UNIT II: NERVOUS SYSTEM

Subject 4. - Nerve cells. Synaptic transmission (1,5 h)
To study the functions of the neuron. Describe the process of myelination. Knowing the properties of the neuron. Describe the events involved in the damage and peripheral nerve repair. Describe the main morphological characteristics of the synapse Distinguish between electrical synapses and chemical synapses. List the steps used in the transmission of impulses across the synapse. Distinguish between excitatory and inhibitory postsynaptic potentials. Define presynaptic inhibition identify the various types of neural circuits in the nervous system. Differences between spatial and temporal summation. Describe the properties of the synapse. List the criteria for identifying a substance as a neurotransmitter. Describe the classification and
### Subject 5. - General structure of the nervous system (1h)
Learn the basic functions of the nervous system. Knowing the functional characteristics of the cranial and spinal nerves. Know the elements of the central nervous system protection. Explain the formation, movement and function of cerebrospinal fluid. Know the meaning of the blood brain barrier.

### Subject 6. - General physiology of receptors (1h)
Differentiate the concepts of sensation and perception. List the types of sensory modalities. Define and classify sensory receptors. Describe the sensory transduction process and differentiate between potential and receptor potential generator. Adapting receptors. Differentiate between fast and slow. Define the concept of receptive field. Describe the process of sensory coding. Describe the location and function of receptors of tactile, thermal and pain sensations. Describe the different types of pain Identify proprioceptive receptors (muscle spindles and Golgi tendon organ) and describe their functions. Describe the modes of transmission and integration somatovisceral cortical sensitivity.

### Subject 7. Physiology of sensory organs (2h)
Know the functions of the structural components of the eyeball. Explain the role of the refraction, accommodation and constriction in imaging. Describe the functions of the photoreceptors and photopigments in vision. Adapting known vision receptors to changes in light intensity. Describe binocular vision and the ability to perceive the depth and three-dimensional nature of the objects. Understand the concept of visual acuity. Describe the processing of visual impulses in the retina and the visual pathways and centers of integration. Describe the functions of the structures that make up the three main parts of the ear. Describe the characteristics of a sound wave. Describe the process of capture and conveyance of a sound wave. Knowing sensory transduction in fonorreceptores. Describe the coding of frequency, intensity and sound localization. Identify pathways and nuclei involved in the neural processing of auditory information. Describe the function of the macula in the static and dynamic balance (linear acceleration and deceleration). Describe the function of the ampullary crests in rotational acceleration or deceleration. Identify vestibular pathways and integration centers. Knowing the structure of gustatory and olfactory receptors. Describe the physiology of taste and smell. Describe the pathways and centers for gustatory and olfactory sensitivity.

### Subject 8. - Control Motor Activity (1h)
Describe the motor neuron-muscle ratio. Enumerate the sequence of events and ionic power ranging from the production of an action potential in the motor nerve to the contraction of a skeletal muscle. Describe how you conducted the cross-bridge cycle and shortening the sarcomere. Knowing the function of the calcium ion in the contraction-relaxation. Explain the sum of contractions and length-tension relationships and force-velocity.

### Subject 9. - Autonomic Nervous System (1h)
Compare the autonomic and somatic nervous systems. Describe the functions of preganglionic and postganglionic neurons in the autonomic nervous system. Describe the organization and synaptic transmission in the sympathetic and parasympathetic nervous systems. Indicate the neurotransmitters and receptors of the sympathetic and parasympathetic nervous systems and its exceptions. List the physiological effects of the autonomic nervous system. Explain the functional relationship of the hypothalamus with the autonomic nervous system. Explain the mechanisms that regulate and control the intake of water and food.

### Subject 10. - Higher functions of the nervous system (1h)
Explain the cellular basis of sleep-wake rhythms and their possible role. Explain the cellular basis of learning and memory.

### Subject 11. Skeletal and visceral muscle physiology (1,5 h)
To explain the functional differences between skeletal, cardiac and smooth muscle. To explain the general concepts of neuromuscular union.

THEMATIC UNIT III: BODY FLUIDS AND BLOOD

Subject 12. Body Fluids. The blood (1 h)
Describe the compartments that distribute water from the body. Give an overview of the components of blood.
Give an estimate volume percentages and formed elements. Describe the formed elements of the blood and their functions. Describe the functions of the blood. Understand what haematocrit value and clinical utility. Describe the main plasma components and their functions. Describe the different types of plasma proteins and their functions

Subject 13. Physiology of the erythrocyte and leukocyte (1h)
Describe erythropoiesis and its regulation. Explain the production and degradation of hemoglobin. Describe the role of iron and its main metabolic aspects. Knowing the current theories of the stem cells. Explain how to determine the ABO blood groups and Rh factor. Describe leukopoiesis. List the functions of neutrophils, eosinophils and basophils

Subject 14. Platelet physiology and hemostasis (1h)
Explain the formation of the platelet clothe. Describe the mechanisms that contribute to hemostasis. Identify the stages of blood coagulation and explain the various factors that stimulate and inhibit. List the hemostatic regulatory mechanisms

THEMATIC UNIT IV: ENDOCRINE SYSTEM

Subject 15. General organization of the endocrine system. Neuroendocrine Integration (1,5h)
Define the terms endocrine gland and hormone. Identify various endocrine glands and the hormones they secrete. List a number of criteria that identify a substance as a hormone. Know the classification of various hormones. Know the processes of synthesis, secretion and hormone transport and metabolism. Describe the types of signals that can regulate the secretion of hormones. Describe the general mechanisms of hormone action. Explain the functional relationship between the hypophysis and hypothalamus. Describe the functional implications of hypothalamic-pituitary portal system. List the hormones of the adenohypophysis and neurohypophysis and explain how its secretion is regulated by the hypothalamus

Subject 16. Thyroid physiology (1h)
Knowing thyroid hormones. Describe the biological actions and mechanisms of regulation of thyroid hormone secretion.

Subject 17. Hormonal regulation of protein metabolism and growth (1,5h)
Describes the mechanisms of action of the major hormones involved in protein metabolism. Describe the metabolic effects and mechanisms of regulation of GH secretion. Meet other factors and hormones involved in growth.

Subject 18. Hormonal regulation of both glycaemic and lipid metabolism (1,5h)
Describes the mechanisms of action of the major hormones involved in lipid and glycaemic metabolism.

Subject 19. Hormonal regulation of water-salt balance (1h)
Knowing the role of mineralocorticoids in the regulation of water and electrolyte homeostasis. Describe some of the major biological actions of aldosterone. Describe the biological actions of ADH and how its secretion is regulated. Describe the renin-angiotensin-aldosterone activation mechanisms and functions.
Subject 20. Hormonal regulation of metabolism calcium/phosphorus (1h)
Know the different types of bone cells. Describe the interaction between the plasma levels of calcium and parathyroid hormone and calcitonin. Describe the biological actions and mechanisms of regulating the secretion of parathyroid hormone, vitamin D hormone and calcitonin.

THEMATIC UNIT V: CARDIOVASCULAR SYSTEM

Describe the function of the heart chambers and valves. Explain the functional characteristics of the myocardium. List the properties of the myocardium. Explain the functional characteristics of the cardiac conduction system. Explain the significance of the electrocardiogram (ECG) and its diagnostic significance.

Subject 22. Cardiac cycle. Cardiac output and factors affecting it. (1,5h)
Explain the temporal sequence of contraction-relaxation in the cardiac cycle. Explain and relate the pressure changes that occur in the cardiac chambers with valves dynamics and blood movements during the cardiac cycle.
Explain the origin and components that produce heart sounds. Define cardiac output and describe the factors that affect it: stroke volume and heart rate. List the factors controlling stroke volume and heart rate.

Subject 23. General circulation and microcirculation. (2h)
Describe and differentiate the function of arteries and veins. Schematize the general circulation. Explain the factors that regulate the rate and blood flow. Define the concepts of systolic, diastolic, and mean differential blood pressure. Describe the mechanisms that are implemented in the short, medium and long-term blood pressure control. Explain the main determinants of the venous circulation. Differentiate the function of arterioles, capillaries and venules. Describe the organization of the microcirculatory unit. Analyze the pressures associated with the movement of fluids and substances between capillaries and interstitial spaces. Describe the circulation of the lymphatic vessels. Describe the formation and flow of lymph. Understand the functions of lymph.

Subject 24. Cardiovascular regulation. (1h)
Explain the heart self regulation. Explain the role of baro- and chemoreceptors in the control of the cardiovascular activity. Know the functioning of the nerve centers in the cardiocirculatory activity control.

THEMATIC UNIT VI: RESPIRATORY SYSTEM

Subject 25. - Morphofunctional structure of the respiratory system. Mechanical ventilation. (1.5h)
Describe the function of the respiratory tract. Describe the processes causing inspiration and expiration. Explain what is meant by surface tension and the role of alveolar surfactant. Describe and differentiate anatomic dead space and physiologic dead space. Define and quantify lung volumes and capacities. Describe the unique characteristics of the pulmonary circulation.

Subject 26. - Exchange and transport of respiratory gases. (1h)
Knowing the partial pressures of oxygen and carbon dioxide in the atmosphere, alveoli, blood and tissues, and based on that describe the diffusion of gases. Describe the different ways in which oxygen and carbon dioxide is transported by the blood. Explain the role of hemoglobin in the transport of CO2.

Subject 27. - Regulation of respiration. (1h)
Describe the areas of the central nervous system and the mechanisms involved in the nervous control of respiration. Explain peripheral mechanisms that contribute to the maintenance of normal breathing patterns. Describe the role of central and peripheral chemoreceptors on breathing control.
THEMATIC UNIT VII: RENAL SYSTEM

Subject 28. - Morphological-functional structure of the excretory system. The nephron. (1h)
Make a list of kidney functions. Describe the functional anatomy of the nephron. Know the structure and function of the juxtaglomerular apparatus.

Subject 29. - Mechanisms of urine formation. (1h)
Define glomerular filtration explaining the mechanisms that produce it. Explain the basic mechanisms of tubular reabsorption and secretion. Explain the countercurrent mechanism. Explain the mechanisms and factors involved in the concentration and dilution of urine. Explain the concept of urine clearance and usefulness. Explain the mechanisms and stages that occur in urination. Knowing the self and endocrine regulation of glomerular filtration. Describe the role of the renin-aldosterone-angiotensin system in the reabsorption and secretion of electrolytes. Understand the role of antidiuretic hormone on water reabsorption in the renal tubules.

Subject 30. Regulation of acid-base balance. (1h)
Relate hydrogen ion secretion by the kidney in the maintenance of acid-base balance. Explain the importance of buffer systems for the acid-base balance. Define the concepts of acidosis and alkalosis. Describe the importance of the respiratory system in the regulation of acid-base balance

THEMATIC UNIT VIII: DIGESTIVE SYSTEM

Subject 31. Functional structure of the digestive tract. Smooth muscle. Motility of the alimentary tract (1h)
To identify the organs of the digestive tract. To describe the caps that form the wall of the alimentary tract. To describe the general functions of the alimentary tract. To describe the mechanism of contraction and the properties of the smooth muscle. To explain the mechanisms of the swallowing and transport of the food up to the stomach. To enumerate the factors that regulate the voidance of the stomach. To enumerate the different types of intestinal motility and to describe the functions of each one. To explain the mechanisms involved in the defecation reflex.

Subject 32. Digestive Secretions (1h)
To describe the composition, function and regulation of the salivary secretion. To describe the composition, function and regulation of the gastric secretion. To describe the composition, function and regulation of the pancreatic secretion. To explain the functional organization of the hepatic lobule. To describe the composition, function and regulation of the biliary secretion. To explain the enterohepatic circulation. To explain the functional organization of the intestinal hairinesses. To describe the composition, function and regulation of the intestinal secretion.

Subject 33. Digestion and absorption (1h)
To know the basic beginning of the gastrointestinal absorption. To describe the digestion and absorption of carbohydrates. To describe the digestion and absorption of proteins. To describe the digestion and absorption of fats. To explain the absorption of water and electrolytes. To explain absorption of vitamins.

THEMATIC UNIT IX: REPRODUCTIVE FUNCTION

Subject 34. Morphologic and functional structure of the reproductive system (1.5h).
Knowing the physiology of male sexual organs. Describe the stages of spermatogenesis and functions of Sertoli’s cells in this process. Function of seminal vesicles and prostate gland. Describe the hypothalamic-hypophysary-testicular control of testosterone secretion. Puberty and regulation of its beginning. Knowing the physiology of the female sexual organs. Describe the different stages of ovarian and menstrual cycles. Explain
hormonal interactions involved in the control of ovulation. Describe the biological actions of testosterone, estrogen and progesterone. Describe the hypothalamic-hypophysary-ovarian control the secretion of estrogen and progesterone. Compare the various types of methods of birth control and its effectiveness.

Subject 35. Physiology of fecundation, pregnancy, childbirth and lactation (1h)
Describe the structure and functions of the placenta. Know the placenta secretes hormones and describe their actions. Describe the evolution of the plasma levels of estrogen, progesterone and chorionic gonadotropin throughout gestation. List the functional changes in the endocrine glands of women during pregnancy. Explain the mechanisms triggering hormonal birth. Describe the interactions of various hormones in the initiation and maintenance of breastfeeding

LABORATORY PRACTICE PROGRAM

Practice 1. Detailed functional study of different organs and body systems models. (3h)
Practice 2. Blood cell count and morphology by mean of the optical microscope. (3h)
Practice 3. Determination of hemoglobin and hematocrit. Automatic counting of leukocytes and erythrocytes (3h)
Practice 4. Blood Pressure assessment. Glycemic profile. (3h)
Practice 5. Respiratory system assessment by mean of spirometry (3h)

SYSTEM FOR ASSESSING THE ACQUISITION OF THE COMPETENCES AND KNOWLEDGE

I. Continuous Assessment

This is the default system. Continuous Assessment includes several theory exams which will take place on dates scheduled by the Faculty in coordination with the other subjects offered in the term. Prior to the exam, the lecturer will describe the structure and type of exam questions. Coursework performed by the students (essays, presentations, seminars...) as well as regular attendance and class participation will be also assessed.

The final mark will be calculated according to the following:

Theory: 70%
Laboratory practice: 10%
Coursework (presentations, seminars, etc.) and attendance to class and class activities: 20%

Students must have a minimum score of 5 points/10 in the theory as well as in the laboratory practice components as an indispensable requisite to pass the subject. In no case the marks obtained in other parts of the Continuous Assessment system (coursework and presentations, assistance to theoretical classes, or any other evaluable component that may be mentioned in the Subject Guide), will serve per se to pass the subject and will only contribute to the final mark once the theoretical and practical parts have been passed.

II. Single Final Assessment

According to the Students Assessment and Qualification Policy of the University of Granada (adopted by the Governing Council on Oct 26, 2016), those students who cannot follow the continuous assessment system due to working, health or disability issues (or any other reason appropriately justified) can apply for a Single Final Assessment. For this purpose, the student will submit a formal request to the Director (Head) of the Department, arguing and proving (with documented evidence) the reason for not being able to follow the
continuous system. The submission deadline will be 2 weeks after the beginning of the lectures. In extraordinary circumstances, the starting date for counting the 2-week period will be the enrolment date (policy NCG78/9) and, in this case, the student will have to include the proof of enrolment date when making the request. After ten days without the student receiving a written reply from the Director of the Department, it will be understood that the request has been deemed. In case of denial, the student may file, within one month, an appeal to the Rector, who may delegate this task to the Dean or Director of the Centre, exhausting the administrative proceedings.

For students in the Single Final Assessment system, the final mark will be calculated according to the following:

Theory: 90%
Laboratory practice: 10%

Students must have a minimum score of 5 points/10 in both components as an indispensable requisite to pass the subject.

READING

GENERAL BIBLIOGRAPHY:
Print Books:


SPECIFIC BIBLIOGRAPHY:


PERIODIC PUBLICATIONS:

• Physiological Review (https://www.physiology.org/journal/physrev)
• Current Opinion in Physiology (https://www.journals.elsevier.com/current-opinion-in-physiology)
• Annual Review of Physiology (https://www.annualreviews.org/journal/physiol)
• American Physiological Society Journal (https://www.physiology.org/)

MANUALS OF PRACTICE:

• Stabler, T., Peterson, G., Smith, L. PhysioEx 9.0 para Fisiología Humana. Simulaciones de Laboratorio

RECOMMENDED INTERNET LINKS

https://www.dailymotion.com/video/xgsbs
https://www.youtube.com/results?search_query=fisiologi%C3%ADa&ie=utf-8&oe=utf-8&client=firefox-b
http://www.youtube.com/watch?v=L5T81uMVR44 (Sistema Nervioso)
http://www.youtube.com/watch?v=dVidtT4Wjs&feature=related (Sangre)
http://www.youtube.com/watch?v=URHB3RKEs&feature=fvsr (Sistema Respiratorio)
http://www.youtube.com/results?search_query=Sistema+Cardiovascular&oq=Sistema+Cardiovascular&gs_l=youtube-reduced.3..0l4.10418.14237.0.14404.22.13.0.9.9.1.154.1399.4j9.13.0...0...0...1ac._JWsGUPeTe0
http://www.youtube.com/watch?v=8af1Cpustf0&feature=related (Coagulación)
http://www.youtube.com/watch?v=HiT621Prr0Q&feature=related (Sistema Muscular)
http://www.youtube.com/watch?v=URHB3RKEs&feature=fvsr (Sistema Renal)
http://www.youtube.com/watch?v=aQZaNXNroYY&feature=related (Sistema Renal)
http://www.youtube.com/watch?v=URHB3RKEs&feature=fvsr (Sistema Renal)
http://www.youtube.com/watch?v=dVidtT4Wjs&feature=related (Sangre)
http://www.youtube.com/watch?v=URHB3RKEs&feature=fvsr (Sistema Renal)
http://www.youtube.com/watch?v=dVidtT4Wjs&feature=related (Sangre)
http://www.youtube.com/watch?v=dVidtT4Wjs&feature=related (Sangre)

Scientific societies with educational websites and general websites

http://www.the-aps.org/ The American Physiological Society
http://physoc.org/ The Physiological Society
http://www.secf.es/ Sociedad Española de Ciencias Fisiológicas
http://www.feps.org/ Federación Europea de Sociedades de Fisiología