Information about the subject

Degree: Bachelor of Science Degree in Physiotherapy

Faculty: Faculty of Medicine and Health Sciences

Code: 241205 **Name:** Biomechanics and Applied Physics

Credits: 6,00 **ECTS Year:** 2 **Semester:** 1

Module: MODULE 1: BASIC FORMATION

Subject Matter: Physiology **Type:** Basic Formation

Field of knowledge: Health Sciences

Department: Biomedical Sciences

Type of learning: Classroom-based learning

Languages in which it is taught: Spanish

Lecturer/-s:

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Module organization

MODULE 1: BASIC FORMATION

Subject Matter	ECTS	Subject	ECTS	Year/semester
Anatomy	18,00	Anatomy I	6,00	1/1
		Anatomy II	6,00	1/2
		Cellular and Molecular Biology	6,00	1/1
Physiology	18,00	Biomechanics and Applied Physics	6,00	2/1
		Physiology I	6,00	1/2
		Physiology II	6,00	2/1
Applied psychosocial sciences	12,00	Anthropology	6,00	1/2
		Psychology	6,00	1/2
Statistics	6,00	Biostatistics	6,00	1/1
Modern Language	6,00	English	6,00	1/1

Recommended knowledge

No recommended prior knowledge is required.

Learning outcomes

At the end of the course, the student must be able to prove that he/she has acquired the following learning outcomes:

R1	Knows the axes, planes of movement and joint paths of the different joints of the body.
R2	Knows the different biomechanical tests of exploration.
R3	Knows the biomechanical foundations of physical exercise.
R4	Knows the different phases of human walking and the alterations in walking.
R5	Knows how to use and interpret the different computerized biomechanical equipment.
R6	Develops knowledge base of physical mechanics and elasticity to understand and analyse certain biomechanical situations and processes.
R7	Acquires a formation in concepts and laws of fluid mechanics that allows him to interpret the behavior of fluids in biological processes related to life.
R8	Knows the physical fundamentals of different types of tomography that allow him to understand the operation of various instruments used in medical imaging.
R9	Acquires knowledge of thermodynamics that describes biological processes of energy and heat transmission.
R10	Knows concepts and fundamentals of wave physics and electricity and electromagnetism by relating them to biological effects and processes.
R11	Learns to frame certain physiological processes in a context of physical foundation, relating the causes and effects of these processes according to behaviors established by physical laws and principles.
R12	Knows concepts and physical foundations that allow him to handle with greater rigor certain instruments and means while expanding the information obtained from these instruments as well as the benefits they can offer.
R13	Solves diagnostic problem situations framed in biomechanical and physiological processes by resorting to interpretations and assessments based on physical laws.

Competencies

Depending on the learning outcomes, the competencies to which the subject contributes are (please score from 1 to 4, being 4 the highest score):

BASIC		Weighting			
		1	2	3	4
CB1	Students demonstrate knowledge and understanding in an area of study that is at the core of general secondary education, and is often at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.			x	
CB2	Students know how to apply their knowledge to their work or vocation in a professional way and possess the skills usually demonstrated by developing and defending arguments and solving problems within their area of study.				x
CB3	Students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant social, scientific or ethical issues.			x	
CB4	Students can convey information, ideas, problems and solutions to both specialized and non-specialized audiences.			x	
CB5	Students develop those learning skills necessary to undertake further studies with a high degree of autonomy.				x

SPECIFIC		Weighting			
		1	2	3	4
CE1	Students learn human anatomy and physiology, highlighting the dynamic relations between structure and function, especially of the locomotive system and the nervous and cardio-respiratory systems.				x
CE3	Students identify the factors that influence human growth and development throughout life.			x	
CE4	Students know the principles and theories of physics, biomechanics, kinesiology and ergonomics, applicable to physiotherapy.				x

CE5	Students know the physical bases of the different physical agents and their applications in Physiotherapy.				x
CE6	Students know the principles and applications of measurement procedures based on biomechanics and electrophysiology.				x
CE7	Students know the application of ergonomic and anthropometric principles.				x
CE9	Students assimilate theories of communication and interpersonal skills.	x			
CE10	Learning theories to be applied in health education and in your own lifelong learning process			x	
CE11	Students identify the factors involved in teamwork and leadership situations.		x		
CE13	The structural, physiological, functional and behavioral changes that occur as a result of the intervention of physiotherapy.		x		
CE30	Students determine the Physiotherapy Diagnosis according to the internationally recognized standards and international validation instruments. This competency includes prioritizing the needs of the patient/user to attend with priority to those that most compromise the recovery process.				x
CE41	Students keep the foundations of the knowledge, skills and attitudes of the professional competences updated, through a process of continuous training (throughout life); to critically analyse the methods, protocols and treatments of the care in Physiotherapy and to ensure that they are adapted to the evolution of scientific knowledge.				x
CE47	Students maintain an attitude of learning and improvement. This includes expressing interest and acting in a constant search for information and professional improvement, committing to contribute to professional development in order to improve practice competence and maintain the status that corresponds to a qualified and regulated profession.				x
CE51	Show respect, appreciation and sensitivity to the work of others.			x	
CE52	Develop the ability to organize and lead work teams effectively and efficiently.		x		

TRANSVERSAL	Weighting			
	1	2	3	4

CT1	Decision-making			x
CT2	Problem solving.			x
CT3	Capacity for organization and planning.			x
CT4	Analysis and synthesis capacity.		x	
CT5	Oral and written communication in the native language.			x
CT6	Information management capacity.			x
CT7	Computer skills related to the field of study.		x	
CT8	Knowledge of a foreign language.	x		
CT9	Ethical commitment.			x
CT10	Teamwork.			x
CT11	Interpersonal relationship skills.		x	
CT12	Work in an interdisciplinary team			x
CT13	Critical Reasoning			x
CT14	Work in an international context.	x		
CT15	Recognition of diversity and multiculturalism	x		
CT16	Motivation for quality			x
CT17	Adaptation to new situations.		x	
CT18	Creativity		x	
CT19	Autonomous learning		x	
CT20	Initiative and entrepreneurship		x	

CT21	Leadership.		x	
CT22	Knowledge of other cultures and customs	x		
CT23	Sensitivity to environmental issues.	x		

Assessment system for the acquisition of competencies and grading system

Assessed learning outcomes	Granted percentage	Assessment method
R1, R2, R3, R4, R6, R7, R11	50,00%	TEST TYPE: Multiple choice test with one correct answer out of five possible ones. It allows the student to know in greater detail the contents acquired by him/her. It allows the following generic or transversal competences to be assessed: 2 Problem solving 1 Decision making 13 Critical thinking
	10,00%	PRACTICES: Oral test in which the student is asked to solve practical exercises, clinical cases or problems about the knowledge of the different subjects. It assesses the following generic or transversal competences: 4 Analysis and synthesis capacity. 3 Capacity for organisation and planning. 7 IT Knowledge. 6 Information management skills. 2 Problem-solving 1 Decision-making. 13 Critical thinking. 19 Self-directed learning.
R1, R2, R3, R4, R6, R7, R13	10,00%	WORKS: The student, individually or in a group, elaborates a revision or research topic and presents it, in writing, for the evaluation by the teacher. The following generic or transversal competences are valued: 4 Capacity for analysis and synthesis. 3 Capacity for organisation and planning. 7 Computer skills. 6 Information management skills. 10 Teamwork. 14 Working in an international context. 11 Interpersonal skills. 13 Critical thinking. 19 Autonomous learning. 18 Creativity. 21 Leadership. 20 Initiative and entrepreneurship. 16 Motivation for Quality. 70 Maintaining an attitude of learning and improvement. 72 Knowing one's own skills and limitations.

R1, R2, R3, R4, R6, R7, R13	20,00%	PRACTICAL EXAM: The student is faced with a test in which s/he must demonstrate through practical application the acquisition of certain knowledge. For example, histological or anatomopathological diagnosis, image interpretation or diagnostic tests. This test evaluates the following generic or transversal skills: 13 Critical reasoning. 19 Autonomous learning.
	10,00%	PRESENTATION: The student develops, through an oral presentation, supported or not by audiovisual means, a subject or work commissioned by the teacher. This is the method of evaluation of the Final Degree's Project. At the end of the presentation, the teacher or the audience can ask questions.

Observations

Single assessment is not available in this course, as active student participation in mandatory practical activities is required.

The course *Biomechanics and Applied Physics* consists of two parts:

1. **Theoretical Exam (90%)**
   - **Biomechanics**: 65% of the final grade → Multiple-choice theoretical exam.
   - **Applied Physics**: 35% of the final grade, broken down as follows:
     - Multiple-choice theoretical exam: 72% of that 35%, equivalent to 25% of the final grade.
     - Research project: 14% of that 35%, equivalent to 5% of the final grade.
     - Problem-solving: 14% of that 35%, equivalent to 5% of the final grade.
2. **Assignments**
   - **Biomechanics Assignment (10%)**:
     - Students must perform a biomechanical analysis of a sports or functional movement of their choice, starting from the anatomical position. The analysis should describe the movements required to perform the action and the muscles involved in each phase.
     - The assignment will be presented to the entire class.
   - **Physics Assignment (10%)**:
     - Research project: 14% of the 35%, equivalent to 5% of the final grade.
     - Problem-solving: 14% of the 35%, equivalent to 5% of the final grade.
     - This component is included in the theoretical exam grade.

The final grade is a weighted average of both parts.

?? **Important**: To calculate the average, students must obtain at least a 5 in the Biomechanics part and at least a 4 in the Physics part.

In the second exam session, students will retain the grade of the part they passed and will only need to retake the failed part.**Grades are not carried over to the following academic year.**

Submissions are only accepted until the end of the semester on the scheduled dates, and there is no opportunity to make up missed components.

MENTION OF DISTINCTION:
In accordance with the regulations governing the assessment and grading of subjects in force at UCV, the distinction of "Matrícula de Honor" (Honours with Distinction) may be awarded to students who have achieved a grade of 9.0 or higher. The number of "Matrículas de Honor" (Honours with Distinction) may not exceed five percent of the students enrolled in the group for the corresponding academic year, unless the number of enrolled students is fewer than 20, in which case a single "Matrícula de Honor" (Honours with Distinction) may be awarded. Exceptionally, these distinctions may be assigned globally across different groups of the same subject. Nevertheless, the total number of distinctions awarded will be the same as if they were assigned by group, but they may be distributed among all students based on a common criterion, regardless of the group to which they belong. The criteria for awarding "Matrícula de Honor" (Honours with Distinction) will be determined according to the guidelines stipulated by the professor responsible for the course, as detailed in the "Observations" section of the evaluation system in the course guide.

Learning activities

The following methodologies will be used so that the students can achieve the learning outcomes of the subject:

M1	Master class Problem solving Exposition of contents by the teacher. Explanation of knowledge and skills
M2	Case resolution: Analysis of sample realities - real or simulated - that allow the student to connect theory with practice, to learn from models of reality or to reflect on the processes used in the cases presented.
M4	Personalized attention. Period of instruction and/or guidance by a tutor with the aim of analyzing with the student their work, activities and their evolution in learning the subjects.
M5	Set of tests carried out to know the degree of acquisition of knowledge and skills of the student.
M12	Group work: Group work sessions supervised by the teacher. Knowledge construction through student interaction and activity.
M14	Group work to search, discuss and filter information about the subjects
M15	Seminar, supervised monographic sessions with shared participation
M16	Student's study: Individual preparation of readings, essays, problem solving, seminars.

IN-CLASS LEARNING ACTIVITIES

	LEARNING OUTCOMES	HOURS	ECTS
Theoretical lessons M1, M2, M12	R1, R3, R5, R6, R7, R8, R11, R12, R13	48,75	1,95
Practice lessons M2, M12	R1, R2, R3, R4, R5, R7, R9, R10	6,25	0,25
Office Hours M4	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13	2,50	0,10
Assessment M5	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13	2,50	0,10
TOTAL		**60,00**	**2,40**

LEARNING ACTIVITIES OF AUTONOMOUS WORK

	LEARNING OUTCOMES	HOURS	ECTS
Autonomous work M5, M16	R3, R5, R6, R7, R8, R9, R10, R11, R12, R13	80,00	3,20
Group work M12, M14, M15	R1, R2, R3, R4, R5	10,00	0,40
TOTAL		**90,00**	**3,60**

Description of the contents

Description of the necessary contents to acquire the learning outcomes.

Theoretical contents:

Content block	Contents
Thematic block I: Applied Physics	TOPIC 0: Review of physical-mathematical concepts (2 classes) Physical quantities and their classification, Order of magnitude, Systems of units Dimensional analysis and laws of scale Significant figures, Scientific notation Scalars and vectors Coordinate systems and components of a vector Vector algebra THEME 1: Introduction to mechanics and biomechanics (4 lessons) Physical principles applied to the analysis of human body movement Newton's Laws and conservation of energy, force and force momentum Newton's laws and conservation of energy, Force and momentum, Mass and weight Lever system TOPIC 2: Elasticity and deformation (2 classes) Basic concepts related to the biomechanics of tissue biomechanics Elasticity and deformation Elastic tests Bone elasticity TOPIC 3: Fluid Dynamics, Physical Principles of (3 lectures) hydrotherapy Fluids at rest Fluids in motion Real fluids, viscosity Physical principles of hydrotherapy THEME 4: Thermodynamics (2 lessons) Fundamentals of thermodynamics Laws or principles of thermodynamics Physical fundamentals of thermotherapy TOPIC 5: Radiation and waves, Infrasound and Ultrasound, Ultrasonic Doppler (2 lessons) Mechanical waves: Sound Classifications of waves and properties Infrasound Ultrasound Ultrasonic diagnosis Translated with www.DeepL.com/Translator (free version)
Applied Physics Practice	Assorted problems and application exercises for each topic.
Thematic block II: BIOMECHANICS APPLIED TO PHYSIOTHERAPY:	Justification of biomechanical analysis in physiotherapy. Fields of action. Cost effectiveness in clinical decision making based on biomechanical analysis. Instrumentation in movement analysis. ABC of biomechanics.

Thematic Block III: BIOMECHANICS OF BODY TISSUES	Mechanical properties of bone, tendon, muscle, ligament, cartilage.
Thematic Block IV: FUNCTIONAL BIOMECHANICS OF THE RACHIS, UPPER AND LOWER EXTREMITIES	FUNCTIONAL BIOMECHANICS OF THE RACHIS, UPPER AND LOWER EXTREMITIES
Thematic block V: BIOMECHANICS IN FUNCTIONAL TESTS, JUMPING, POSTURAL AND BALANCE TESTS	BIOMECHANICS IN FUNCTIONAL TESTS, JUMPING, POSTURAL AND BALANCE TESTS
Thematic Block VI: BIOMECHANICS OF GAITING	Conceptual framework of biomechanical analysis according to ICF. 2D video-analysis, 3D kinematics, kinetics, sEMG, energy expenditure.

Temporary organization of learning:

Block of content	Number of sessions	Hours
Thematic block I: Applied Physics	7,00	14,00
Applied Physics Practice	2,00	4,00
Thematic block II: BIOMECHANICS APPLIED TO PHYSIOTHERAPY:	6,00	12,00
Thematic Block III: BIOMECHANICS OF BODY TISSUES	7,00	14,00
Thematic Block IV: FUNCTIONAL BIOMECHANICS OF THE RACHIS, UPPER AND LOWER EXTREMITIES	4,00	8,00
Thematic block V: BIOMECHANICS IN FUNCTIONAL TESTS, JUMPING, POSTURAL AND BALANCE TESTS	3,00	6,00
Thematic Block VI: BIOMECHANICS OF GAITING	1,00	2,00

References

Basic:
BIOMECHANICS:- Perry J, Burnfield JM. Gait Analysis: Normal and Pathological Function. Slack-Gage James R. ; Schwartz, Michael H. (edt) ; Koop, Steven E. (edt). The Identification And Treatment Of Gait Problems In Cerebral Palsy. 2009. Clinics in Developmental Medicine. - Novacheck TF. The biomechanics of running. Gait and Posture 7 (1998) 77-95.- Hay, J. (1993). The biomechanics of sport technique. San Francisco: Pearson Education.- Cook, G., Burton, L., & Hoogenboom, B. (2006). Pre-participation screening: the use of fundamental movements as an assessment of function - part 1. North American Journal of Sports Physical Therapy, 1(1), 62-71.

APPLIED PHYSICS:
- Parisi, M.: Topics in Biophysics. McGraw-Hill Ed. Madrid; 2001
- Buceta, J., Koroutcheva, E., Pastor, J.M. "Temas de Biofísica", Editorial UNED. Colección Cuadernos de la UNED (nº 35275CU01A01); 2006
- KARL HAINAUT, MARIA TERESA POBLET ANDREU, INTRODUCCIÓN A LA BIOMECÁNICA, EDITORIAL MEDICA JIMS S.L. (2017)
- RAUL VILLAR, FUNDAMENTOS FISICOS DE LOS PROCESOS BIOLOGICOS, EDITORIAL CLUB UNIVERSITARIO (2013)
- María Reyes Pérez Fernández, Principios de hidroterapia y balneoterapia, McGraw-Hill Interamericana de España (2005)
- Rodríguez, J., Electroterapia en Fisioterapia, Editorial Medica Panamericana S.A. (2013)
- Joaquín Costa Subias, Resonancia magnética dirigida a técnicos superiores en imagen para el diagnóstico, Elsevier, (2020)
- Joaquín Costa Subias, Juan Alfonso Soria Jerez, Tomografía computarizada dirigida a técnicos superiores en imagen para el diagnóstico, Elsevier, (2021).

Complementary:
BIOMECHANICA:- Surface ElectroMyoGraphy for the Non-Invasive Assessment of Muscles: http://www.seniam.org - MoXie Viewer software that enables you to synchronously view video and concurrently acquired signals (e.g. measured electromyograms (EMG), ground reaction forces, joint angles and three-dimensional marker data): http://moxie-viewer.software.informer.com- Martínez Caballero, I. Abad Lara, JA. Parálisis Cerebral Infantil: Manejo de las alteraciones músculo-esqueléticas asociadas (Infantile Cerebral Palsy: Management of associated musculoskeletal disorders). Ergón Creación, S.A. 2015- Martínez Caballero, I. Ortopedia Y Traumatología Infantil. Ergón Creación. 2015