COURSE OUTLINE: CLINICAL BIOMECHANICS

1. GENERAL

SCHOOL	SCHOOL OF HEALTH SCIENSES		
ACADEMIC INIT	PHYSIOTHERAPY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**PHB5**	**SEMESTER**	**2nd**
COURSE TITLE	**CLINICAL BIOMECHANICS**		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
LECTURES	3	5
LABS	2	1
		6

COURSE TYPE	CMSKB *Compulsory Modules of General Knowledge Background (CMGKB), Compulsory Modules of Specific Knowledge Background (CMSKB), Compulsory Specialisation Modules (CSM), Optional Modules (OM)*
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION & EXAMINATIONS:	GREEK
IS THE COURSE OFFED TO ERASMUS STUDENTS?	NO
COURSE WEBSITE (URL)	https://eclass.uth.gr/courses/PHYSIO_U_137/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Learning Outcomes of the Theoretical Part:

The student, upon completion of the course, will be able to:

1. Understands the function of the human body through the principles of mechanics.
2. Understands, analyzes, and interprets the impact of external and internal loads on tissues and systems.
3. Understands the effects of loading and the mechanical characteristics of individual joint structures and related tissues, as well as their injury mechanisms.
4. Understands biomechanical techniques used to assess human activity.
5. Understands the mechanics of orthopedic internal fixation.

Learning Outcomes of the Laboratory Part:

The student, upon completion of the course, will be able to:

1. Recognizes the necessary equipment for laboratory biomechanical assessment.
2. Utilizes the basic laboratory equipment of the Human Movement and Activity Assessment Lab for biomechanical analysis of human activities, muscle strength, posture, and balance.

3. Differentiates between normal and pathological conditions through the processing and analysis of results collected from this equipment.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Teamwork	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others …*
Production of new research ideas	

- Search, analysis, and synthesis of data and information using the necessary technologies.
- Decision-making.
- Critical thinking and self-reflection.
- Independent work.
- Adaptation to new situations.
- Generation of new research ideas.
- Promotion of free, creative, and inductive thinking.

3. SYLLABUS

A. THEORETICAL PART:

Unit 1: Strength of Biological Materials - Basic Principles

- Fundamental concepts of material strength. Types of loads: compressive, tensile, shear, torsional, bending, and combined loads. Physical quantities characterizing material properties: stress, strain, Young's modulus, shear modulus, Poisson's ratio. Elastic and plastic deformation. Stress-strain diagrams: yield points, fracture points, elasticity, and plasticity. Isotropic, anisotropic, and orthotropic materials.

Unit 2: Viscoelasticity

- Viscoelasticity and its characteristics: hysteresis, rate-dependence, time-dependence, and temperature dependence. Stress-to-time and strain-to-time diagrams of viscoelastic materials. Load relaxation and creep. Biological viscoelastic materials.

Unit 3: Kinetics and Mechanical Properties of Tissues

- Definition and basic principles. Concept of load. Internal & external forces in the human body. Intra-articular and extra-articular loading. Instruments and methods for measuring loads in the human body. Validity and reliability of measurement instruments.
- Mechanical properties of bone, cartilage, ligaments, tendons, and muscles. Bone behavior under compression, tension, and shear. Cartilage behavior under compression and the conversion of compressive loads to tensile forces. Ligament, tendon, and muscle behavior under tensile loading. Mechanical properties of nervous tissue and skin.

Unit 4: Stress on Biological Materials & Injuries

- Fracture limits of bones under mechanical stress in compressive, tensile, shear, bending, torsional, and combined loads. Fracture limits of cartilage under compression and ligaments, tendons, and muscles under tension. Fatigue - mechanical fatigue of biological materials due to repetitive loading. The impact of muscle contraction type and speed on muscle injury. The effects of aging and pathology on the mechanical properties of biological materials.

Unit 5: Muscle Strength Evaluation - Isokinetics

- Methods and instruments for measuring muscle strength. Validity and reliability. Isokinetics: principles, indications, and contraindications. Isokinetics as a method for assessing muscle strength. Evaluation of pathologies through isokinetics.

Unit 6: Balance Assessment

- Center of gravity, base of support, center of pressure, and sway. Methods and instruments for measuring balance. Validity and reliability. Evaluation of static and dynamic balance, as well as pathological balance conditions.

Unit 7: Clinical Biomechanics of the Shoulder and Elbow

- The shoulder and elbow under loading. The role of external and muscular forces in joint pathology. Loading as a provoking factor in the injury of contractile and non-contractile tissues - injury mechanisms. Alteration of load transmission and absorption in pathological conditions.

Unit 8: Clinical Biomechanics of the Wrist and Hand

- The wrist and hand under loading. The role of external and muscular forces in joint pathology. Loading as a provoking factor in the injury of contractile and non-contractile tissues - injury mechanisms. Alteration of load transmission and absorption in pathological conditions.

Unit 9: Clinical Biomechanics of the Spine

- The spine under loading. The role of external and muscular forces in joint pathology. Loading as a provoking factor in the injury of contractile and non-contractile tissues - injury mechanisms. Alteration of load transmission and absorption in pathological conditions.

Unit 10: Clinical Biomechanics of the Hip and Knee

- The hip and knee under loading. The role of external and muscular forces in joint pathology. Loading as a provoking factor in the injury of contractile and non-contractile tissues - injury mechanisms. Alteration of load transmission and absorption in pathological conditions. Loading in pathological gait.

Unit 11: Clinical Biomechanics of the Ankle and Foot

- The ankle and foot under loading. The role of external and muscular forces in joint pathology. Loading as a provoking factor in the injury of contractile and non-contractile tissues - injury mechanisms. Alteration of load transmission and absorption in pathological conditions. Loading in pathological gait.

Unit 12: Biomechanical Principles of Internal Fixation of Fractures

- Biomechanical principles of internal fracture fixation. Stabilization in all axes, minimizing the use of orthopedic materials, achieving mechanical stability, alignment, and anatomical restoration. Principles of mechanical compression and stabilization using screws, plates, intramedullary nails, and tension bands.

Unit 13: Mechanical Properties of Orthopedic Materials and Biomechanics of Internal Fixation of Fractures

- Types of screws (cortical, cancellous, LHS, etc.) and their role in compressing fracture surfaces (lag screw) and stabilizing a plate on the bone (plate screw). Types and five uses of bone plates. Types and applications of intramedullary nails. Types and applications of tension bands. Mechanical properties of orthopedic materials and biomechanics of internal fixation.

Unit 14: Final Student Assessment - Examination

- The overall performance of students is assessed according to the institution’s academic regulations and the course evaluation criteria outlined below.

B. LABORATORY PART:

Unit 1. Laboratory Analysis of the Velocity-Force Relationship: Concentric Contraction

- Comparison of force production during concentric muscle contraction in various joints and at different angular velocities using an isokinetic dynamometer, with student participation. Recording of results, demonstration, and reinforcement of the velocity-force curve of concentric contraction. Student evaluation.

Unit 2. Laboratory Analysis of the Velocity-Force Relationship: Eccentric Contraction

- Comparison of force production during eccentric muscle contraction in various joints and at different angular velocities using an isokinetic dynamometer, with student participation. Recording of results, demonstration, and reinforcement of the velocity-force curve of eccentric contraction. Student evaluation.

Unit 3. Instruments for Measuring Human Body Loading

- Demonstration of instruments for measuring the loading of the human body. Advantages and disadvantages of each instrument. Student participation and familiarization with the instruments and their software. Student evaluation.

Unit 4. Human Body Loading During Walking and Running

- Gait recording on a force platform with student participation. Analysis of results and load diagrams exerted on the body during walking. Running test. Student evaluation.

Unit 5. Human Body Loading During Pathological Gait

- Recording of simulated pathological gait on a force platform with student participation. Analysis of results and load diagrams exerted on the body, compared to normal gait. Student evaluation.

Unit 6. Human Body Loading During Jumping

- Recording of vertical jumps on a force platform at different heights with student participation. Analysis of results and load diagrams exerted on the body during jumping. Student evaluation.

Unit 7. Instruments for Measuring Muscle Strength

- Demonstration of instruments for measuring muscle strength. Advantages and disadvantages of each instrument. Student participation and familiarization with the instruments and their software. Student evaluation.

Unit 8. Isokinetic Evaluation of Muscle Strength During Concentric Contraction

- Recording of muscle strength during concentric contraction in various joints and at different angular velocities using an isokinetic dynamometer, with student participation. Analysis of results and diagrams. Isokinetic evaluation of the flexor-extensor ratio of the knee and the internal-external rotator muscles of the shoulder to detect muscle imbalances and predict injuries. Student evaluation.

Unit 9. Isokinetic Evaluation of Muscle Strength During Eccentric Contraction

- Recording of muscle strength during eccentric contraction in various joints and at different angular velocities using an isokinetic dynamometer, with student participation. Analysis of results and diagrams. Evaluation of neuromuscular control during eccentric muscle contraction. Student evaluation.

Unit 10. Clinical Biomechanics of Upright Posture

- Methods and techniques for evaluating correct and pathological upright posture, with student participation. Analysis of results. Student evaluation.

Unit 11. Instruments for Measuring Balance

- Demonstration of instruments for measuring human body balance. Advantages and disadvantages of each instrument. Student participation and familiarization with the instruments and their software. Student evaluation.

Unit 12. Biomechanics of Balance: Static Balance

- Recording of static balance in various tests using the Balance Manager, with student participation. Analysis of results and diagrams. Simulation of pathological static balance and comparison with normal balance. Student evaluation.

Unit 13. Biomechanics of Balance: Dynamic Balance

- Recording of dynamic balance in various tests using the Balance Manager, with student participation. Analysis of results and diagrams. Simulation of pathological dynamic balance and comparison with normal balance. Student evaluation.

Unit 14. Final Student Assessment - Examination

- The overall performance of students is assessed according to the academic regulations of the institution and the course evaluation criteria stated below.

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	**Face-to-Face Instruction** The teaching methods for the theoretical part of the course include a variety of instructional approaches and tools, such as: • Lectures and presentations using a whiteboard, overhead projector, fixed projection system, video, and television. • Classroom discussions and feedback. The laboratory part of the course is taught using the following methods and tools: • Demonstration and application of anatomical landmarks on anatomical models. • Small group work. • Student presentations. • Case studies. • Clinical application.
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Use of ICT in Teaching, Laboratory Training, and Student Communication** Theoretical Part: • Utilization of Information and Communication Technologies (ICT), including the Internet, multimedia, electronic discussions via an asynchronous learning platform, and email. Laboratory Part: • Utilization of Information and Communication Technologies (ICT), including the Internet, multimedia, electronic discussions via an asynchronous learning platform, and email.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS.*	<table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>45</td></tr><tr><td>Laboratory Exercises</td><td>30</td></tr><tr><td>Independent Study</td><td>75</td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>Couse Total</td><td>150</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation*	**Student Performance Assessment** The assessment criteria for student performance are available

procedure *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically defined evaluation criteria are given, and if and where they are accessible to students.*	on the course website and are specified as follows: **Theoretical Part:** Evaluation is conducted either through a final written examination (or an oral examination in the presence of two professors) or in combination with an intermediate assessment (progress test). The final course assessment takes place after the end of the teaching semester and covers the entire syllabus taught. Students are required to answer questions (essay-type or multiple-choice) that evenly cover all course units, as well as questions requiring critical thinking. The final grade for the theoretical part is on a scale of 0-10 and is determined by the final examination or, in the case of an intermediate assessment, by a predetermined weighting coefficient set at the beginning of the semester. **Laboratory Part:** In each laboratory session, student participation and ability to address assigned problems are assessed by the instructor. The successful resolution of the given instructional example, under the instructor's guidance, is evaluated. Students must have successfully completed at least 80% of the assigned exercises to be eligible for the final examination. The final laboratory examination is oral, conducted in the presence of two professors, during which students must solve practical problems and demonstrate required skills (e.g., patient history-taking, objective assessment, etc.). The topics assessed evenly cover all course units. The final laboratory grade is on a scale of 0-10 and is determined by the final examination. Student performance is assessed according to the institution's regulations, based on the combined evaluation of the theoretical and laboratory parts. The weighting factors for each part sum to 1 and depend on the credit allocation of each section. Successful completion of both the theoretical and laboratory parts is a prerequisite for passing the course. The final grade is recorded on a ten-point scale (0-10), with a minimum passing grade of 5.

5. ATTACHED BIBLIOGRAPHY

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22. Πουλμέντης, Π. Βιολογική Μηχανική-Εργονομία. Κ. Καπόπουλος, Αθήνα, 2007.
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- *Συναφή επιστημονικά περιοδικά:*

1. Journal of Biomechanics (https://www.sciencedirect.com/journal/journal-of-biomechanics)
2. Clinical Biomechanics (https://www.sciencedirect.com/journal/clinical-biomechanics)
3. Gait and Posture (https://www.sciencedirect.com/journal/gait-and-posture)
4. Journal of Kinesiology and Electromyography (https://www.sciencedirect.com/journal/journal-of-electromyography-and-kinesiology)