Course Title	**Clinical Biomechanics – Pathokinesiology – Ergonomics**				
Course Code	PHYS207				
Course Type	Compulsory				
Level	Bachelor (Level 1)				
Year / Semester	2^{d} / Fall				
Instructor's Name	Prof. Spyridon Athanasopoulos, Dr Anthi Xenophontos				
ECTS	6	**Lectures / week**	2	**Laboratories/week**	2
Course Purpose	The aim of the course is to introduce students to the concept of clinical biomechanics, so that they are able to know the biological materials of the human body and the loads that will be imposed with exercises and daily activities and the detailed control of the movement of body parts, including joint structures, muscles and the nervous elements it includes. They will also recognize the wrong movement patterns – skeletal malformations, muscle imbalances, nervous system disorders – that lead to the appearance of musculoskeletal pain syndromes, movement restriction and a reduction in the individual's functionality. This knowledge is necessary not only for the evaluation and planning of rehabilitation but also for the contribution of the physiotherapist to the ergonomic design of the working environment with the main goal of prevention, maximizing the performance of the employee while preserving and protecting human resources.				
	Course Learning Outcomes				**Aligned PLOs**
Learning Outcomes	Upon completion of the theoretical part of the course, students are expected to be able to:				
	1. Define the basic concepts and definitions of basic terms of engineering: the mechanical properties and especially the load resistance of biological materials. (bones, collagen tissues, articular cartilage, muscles).				K1 & K2
	2. Analyze the mechanical, metabolic, and other disadvantages resulting from injuries, immobilization, lack of exercise age and ways of intervention to minimize or even eliminate the adverse effects on all systems of the organism.				C1, C2 & C4
	3. Identify the salivated motor patterns caused by skeletal malformations, muscle imbalances, disorders of the nervous system, leading to the appearance of				AN1 – AN3, K1&K2

	musculoskeletal pain syndromes, restriction of movement and a decrease in the functionality of the person.	
	4. Prepare exercise programs to restore incorrect motor patterns. assess the impact of gravity and loads when managing weight.	AN1,AP1-AP4
	5. Organize ergonomic interventions aimed at maximizing the performance of the employee and the prevention of musculoskeletal disorders.	K1, S1-S3
	6. Analyze professional activities by recording and measuring the loads that develop in the musculoskeletal system and the effect of its conditions.	E1,AN1-AN3
	7. Use of contemporary digital technology in the analysis and treatment of complex pathokinesiological movements and patterns	AP1, AP3, AP4,E3
	8. Recommend ergonomic adjustments and programs, cooperating appropriately with the scientists involved in the scientific ergonomic team and using each time appropriately “tools" for recording and evaluating the activity of employees.	K2,E1-E3
	9. Demonstrate techniques of improving the posture, movement and functionality of the individual in the context of everyday life and professional activity	AP1-AP4
	10. Formulate the techniques of optimizing the performance of the employee, through the management and prevention of problems - pain - overuse by the musculoskeletal system	S1-S3
	11. Implement the ‘International classification of functioning’ system for neuromusculoskeletal and biomechanical movement disorders related (joint mobility, muscle tone and power, complex movements and deviations from normal kinesiological patterns)	K1, AP1- AP4

Prerequisites	None	Co-requisites	None
Course Content	**Theory** • Forces, torques, loads (definitions). Elements of strength of materials. • Simple stress: tensile, compression, shear, bending, torsion, • Complex stress, dynamic stress, stresses, and deformations (elongated and shear)		

	• The mechanical properties of biological materials (bones, collagen tissues, articular cartilage, muscles and skin): elasticity, plasticity, sliminess, strength and sliminess. • Stresses – deformities, creep phenomenon, stress relaxation. • Factors determining the mechanical behavior of biological structures:(Collagen tissue, Bones, Articular cartilage, Muscles) • The adaptations of biological materials to immobilization lack of exercise, age and exercise. • The functional role in the movement of the articular receptors, free nerve endings, the muscular spindle, the Golgi tendon organ • Neurogenic factors and disorders of muscle mobilization (inhibition), dysfacilitation • Dysfunction of the shoulder girdle from traumatic instabilities, from neck pain and from deviations of the thoracic spine, • Mechanisms of movement disorder by dysfunctional alignments of the lower limbs, (varus-valgus, flat feet). • Adjustments of muscle activation and movement in painful syndromes and injuries– differentiated efferent impulses – articular abductor root canal. • Joint movement disorders due to muscle inelasticity and muscle imbalances of competitive muscles. • Increase and decrease of spinal curvatures and decreased stabilizing capacity of the muscles in the area. • Gait disturbance, due to imbalance, quadriceps muscle weakness, gluteus maximus, gluteusmedius, hamstring shortening and lumbar rhythm disorder. • Methodology of the assessment and clinical reasoning according to the 'International classification of functioning' system for neuromusculoskeletal and biomechanical movement disorders related (joint mobility, muscle tone and power, complex movements and pathokinesiological patterns • Restoration of functional motor patterns of brain plasticity. • Ergonomics. Definitions, basics. Human-machine interaction. • Programs for the prevention and improvement of motor patterns, lumbar spine, trunk, cervical spine (back school, neck school, counseling in coexisting pathological conditions) • Health and safety at work. Epidemiological data related to professional activity and working conditions. ·

	• Musculoskeletal and psychological burden. Anxiety, burnout, harassment/pain, musculoskeletal syndromes. Prevention. • Preventive physiotherapy. Evaluation and physiotherapeutic intervention aimed at the functional rehabilitation and "social adequacy" of the individual. • The role of the occupational Physiotherapist as a clinical expert and his contribution to rehabilitation, work organization, teaching and research. • Participation in the organization, improvement of systems, procedures, for service and care of patients. **Laboratory** • Practice, in gait disturbances, in the dysfunction of the muscles of the shoulder girdle. • Evaluation in the muscular synergistic pairs of the movement of the scapula. • Investigation of strength and length disorders of the muscles of the lower extremities in skeletal malformations. • Evaluation of muscle imbalances in patients with increased spinal curves and pelvic deviations. • Structuring programs for the rehabilitation of disturbed motor patterns. • **Practicing in the assessment and clinical reasoning according to the 'ICF' system for neuromusculoskeletal related disorders (joint mobility, muscle tone and power, complex movements and pathokinesiological patterns)** • Prevention of musculoskeletal disorders. Exercises. Applications • Principles of ergonomic organization of the workplace. Aggravating positions, postures for the musculoskeletal system. • Musculoskeletal in everyday life. Assessment of burdens on musculoskeletal structures. • Prevention of musculoskeletal stress. Preventive physiotherapy programs • Adaptation of daily activity based on ergonomic principles. • Assessment and evaluation of loads in daily activity - prevention of musculoskeletal disorders in everyday life (infant-mother care, daily routine of student, home care worker, etc.). • Ergonomic intervention, preventive physiotherapy programs, • Organization in workplaces with the aim of optimizing the performance of the employee, at the same time his safety and protection from burdens, the

	reduction of accidents and absences due to illness with benefits for employers and employees.
Teaching Methodology	**Theory** The course is delivered to the students through lectures, using computer-based presentations programmes. Case Studies, Discussion, Questions / Answers are also used depending on the content of the lecture. Lecture notes and presentations are available online for use by students in combination with textbooks. Relevant material published in international scientific journals is also used to follow the latest developments related to the subject of the course. **Laboratory** During the laboratory courses, students develop their clinical skills in skill trainers and patient simulators so that they can successfully and safely apply them in a real clinical environment.
Bibliography	**Textbooks:** Jacquelin Perry, M. D. (2010). Gait analysis: normal and pathological function. New Jersey: SLACK. Kirtley, C. (2006). Clinical gait analysis: theory and practice. Elsevier Health Sciences. Whittle, M. W. (2014). Gait analysis: an introduction. Butterworth-Heinemann. M. Nordin & V. Frankel, 2001, «Basic Biomechanics of the Musculoskeletal System», Lippincott Williams & Wilkins, USA J. Rose & J. G. Gamble, 1994 «Human Walking», Williams & Wilkins, USA Ch. Vaughan, B. Davis, J C. O'Connor, 1992 «Dynamics of Human Gait», Human Kinetics, Publishers, Illinois F. Kendal, K. Mcreary, (1993), Muscles testing and function, 4th edition, New York William & Wilkins. L don Lehmkuhl, Laura K. Smith (2002), Brunnstrom's Clinical Kinesiology, Philadelphia, F.A Davis Company. Donald A. Neumann, PT, Phd, (2010), Kinesiology of the Musculoskeletal System, Foundations for Physical Rehabilitation, Mosby. Frankel V, Nordin M. 2012, Basic Biomechanics of the Musculoskeletal System4th Edition, Baltimore Lipincott, Williams & Wilkin. Salvendy G, (2012) Hand book of Human Factors and Ergonomics 4th edition New Jersey: John Wiley and Son's.

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<tr><td></td><td colspan="3">Loisel P, Anema J. 2013, Handbook of work disability: Prevention and management. NY: Springer.

Kriebel D, Jakobs M, Markkanen P, et al. 2011, Lessons Learned. Solutions for workplace safety and health. University of Massachusetts: Lowe.

Berry C. A 2009, Guide to Ergonomics. Occupational Safety and Health Division. North Carolina: Department of Labor.

Bradley D, Clifton-Smith T. Breath, Stretch and Move. Get Rid of Workplace Stress. New Zealand: Random House, 2013.

<u>References</u>:

Armand, S., Decoulon, G., & Bonnefoy-Mazure, A. (2016). Gait analysis in children with cerebral palsy. EFORT open reviews, 1(12), 448-460.

Cimolin, V., & Galli, M. (2014). Summary measures for clinical gait analysis: A literature review. Gait & posture, 39(4), 1005-1010.

Saraiva, L., da Silva, M. R., Marques, F., da Silva, M. T., & Flores, P. (2022). A review on foot-ground contact modeling strategies for human motion analysis. Mechanism and Machine Theory, 177, 105046.

Occupational Safety & Health Administration. Ergonomics for the prevention of the musculoskeletal disorders. USA: Department of Labor, 2009. Available at: http://www.osha.gov/ergonomics/guidelines/nursinghome/final_nh_guidelines.pdf.</td></tr>
<tr><td></td><td>Assessment Method and Description</td><td>Weight</td><td>Aligned CLOs</td></tr>
<tr><td>Assessment</td><td>Group Solving problem - Case studies to assess how students can apply theoretical knowledge to real-life situations. Students are presented with scenarios that require analysis, critical thinking, and the application of theoretical concepts and they are assessed based on their ability to perform verbal presentations, viva voce examinations, identify and evaluate relevant information, propose solutions, and provide justifications for their choices.</td><td>15%</td><td>1 -11</td></tr>
<tr><td></td><td>Online quizzes and interactive assessments: Online quizzes and interactive assessments, reflective writing will be used through the Moodle platform, to create quizzes with various question formats. These assessments will be timed, and immediate feedback can be provided to students.</td><td>10%</td><td>1,2,5,6,8</td></tr>
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	Peer and self-assessment: Students are assigned to review and provide feedback on each other's work, encouraging them to critically evaluate their peers' understanding and provide constructive suggestions. **Laboratory** evaluation consists of assessment of the expected skills and competences, critical thinking, problem-solving and teamwork skills. During the laboratory sessions, students are closely observed as they engage in the assigned tasks and note is taken regarding the actions, approach and any relevant observations that demonstrate their understanding of the subject matter and application of skills. After assessing the laboratory work, constructive feedback is provided to students. Their strengths and areas for improvement are highlighted, linking them back to the learning outcomes to help students understand their progress and guide them towards further development. Depending on the nature of the laboratory work, peer assessment can be incorporated, where students evaluate each other's work based on the established criteria to promote self-reflection, collaboration, and a deeper understanding of the subject matter. **Final Exam (50%):** comprehensive final exam, to assess students' overall theoretical knowledge. These assessments cover a broader range of topics and learning outcomes from the entire program of study, to gauge the students' understanding and integration of knowledge across different areas.	5% 20% 50%	1,2,8 1-11 1-11
Language	Greek / English		