BIOMECHANICS IN REHABILITATION

Course Code PTHE-305	**Course Title** Biomechanics in Rehabilitation	**Credits (ECTS)** 3 (6)
Program Physiotherapy BSc	**Semester** Summer	**Perquisite** None
Module Type Mandatory	**Scientific Area** Health Sciences	**Language** English
Module Level Undergraduate	**Teaching Year** 3o Year	**Module Co-ordination** Dr. Manos Stefanakis
Day/Time of Delivery Monday - Thursday 10.00-12.30		**Teaching Venue** Research & Technology Building Physio Room 138
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Module Aims:

This module aims to offer an understanding of kinematic (displacement, time, speed, velocity, etc) and kinetic (forces, moments, load distribution) variables of human movement and the ways and tools to evaluate and quantify them. In addition students will learn to appreciate the different forms of loading in the living tissues and the mechanical, the biological and the biochemical effect the have on tissue homeostasis. Last but not least of the aim of this course is to provide the students the necessary understanding of how to use the knowledge of tissue loading in real practice when they are called to design ergonomic and therapeutic interventions in order to prevent or rehabilitate injuries or facilitate performance.

Module Objectives:

At the end of the **theoretical part** of the module, students will be able to:

1. Understand the different kinetic and kinematic variables of human movement and how to evaluate them both quantitatively and qualitatively
2. Recognize and appreciate the mode of loading in various structures and tissues of the

human body during movements, activities or postures
3. Predict the effect of a particular mode of loading in biological tissues and the probability of injury
4. Understand and explain (in scientific and lay language) terms like stress, strain, fatigue, overuse, stress adaptation etc after the application of a loading regimen
5. Understand and implement the basic principles of ergonomics and occupational loading in their assessment and treatment repertoire
6. Design and implement ergonomic interventions (in collaboration with other experts such as medical doctor, engineers, architects, psychologists, etc)
7. Analyse relevant biomechanical and physiological data and create reports efficiency of human movement
8. Develop the necessary knowledge to understand the relevant literature in order to increase its knowledge in the field of human biomechanics

At the end of the **practical part** of the module, students will be able to:

1. Analyse movements in various planes and axis and determine the mode of loading sustained by different structures of the human body.
2. Assess and modify mechanical loading in order to prevent or rehabilitate musculoskeletal problems resulting from occupational loading
3. Appreciate the magnitude of mechanical loading in sporting and everyday activities and suggest ways or strategies to reduce it

Module Content:

1. Introduction to basic terms of biomechanics (forces, moments, Newton's Laws of movement, moment arms, levers, axis and planes of movement, forces couples, kinematics, kinetics, osteokinematics, arthokinematics, stability, etc)
2. Parameters of tissue loading (magnitude, repetition, frequency, resting time, distribution or concentration of load, stress shielding, etc)
3. Mechanical properties of tendons, ligaments, bones, articular cartilage, intervertebral disc and nerves
4. Basic principles of ergonomics, ergonomic assessment and intervention in the workplace
5. Biomechanics and evaluation of human gait
6. Stability of joints and its requirements
7. Biological, Biochemical and mechanical implications of tissue loading
8. Overuse and fatigue syndromes and preventative strategies

Teaching Methods:

- ❖ Power Point Presentations
- ❖ Use of audiovisual means, such as video projections
- ❖ Group assignments in class
- ❖ Interactive sessions on qualitative movement analysis
- ❖ Practical sessions in gait analysis lab
- ❖ Practical demonstrations of isokinetic assessment
- ❖ Practical assessment of EMG activity

Learning Experiences

- **Directed Learning** involves guidance to relevant literature and journal articles for studying. Students will also be prompted to explore key issues from musculoskeletal anatomy in preparation of each session. Questions and small quizzes will be given to assess their understanding of the topics taught
- **Self-Directed Learning** involves the student in independent learning. The students are provided with key references and web sites for self learning.
- **Lectures** in power point presentations will coven the theoretical part of course as described in the learning outcomes (20 hours)
- **Practical Classes** will enable students to develop practical skills as described in the learning outcomes. (10 hours).
- **Case Studies** scenarios enable the student to identify and analyse pathological movement. The students are then asked to recognize the basic principles of rehabilitation stemming from this analysis e.g pathological activity due to decreased range of joint movement would require techniques to increase ROM. Clinical reasoning is subconsciously developed through these, by learning to combine examination findings, therapeutic goals and therapeutic means.

Assessment:

Midterm Exam (written)	40 %
Participation-Interest-Presence	10 %
Final Exams (written)	60 %

Essential Reading:

Authors	Title	Publisher	Year	ISBN
Neumann D.	Kinesiology of the Musculoskeletal System, 2nd Ed	Mosby	2010	9780323039895
Nordin M. and Frankel V.H.	Basic biomechanics of the musculoskeletal system. 4th Ed	Lippincott Williams & Wilkins	2012	978609133351
Susan Hall	Basic Biomechanics 6th Ed.	McGraw-Hill	2011	978-0073376448
Enoka Roger	Neuromechanics of Human Movement-4th Edition	Human Kinetics	2008	978-0736066792

Suggested Reading:

Authors	Title	Publisher	Year	ISBN

Ramachandran M	Basic Orthopaedic Sciences: The Stanmore Guide.	HodderArnold	2006	
J Hamill & K Knutzen	Biomechanical Basis of Human Movement 3rd Ed.	Lippincott Williams & Wilkins	2009	
B. Abernethy, V. Kippers, S.J. Hanrahan, M.G. Pandy, A.M. McManus, and L. Mackinnon	Biophysical Foundations of Human Movement 3rd Ed.	Human Kinetics	2013	

Selected Web sites:

- https://isbweb.org/ (International Society of Biomechanics)
- http://www.clinicalgaitanalysis.com/ (excellent resource for gait analysis)
- https://wwrichard.net/ (Walking with Richard, excellent resource on gait analysis and biomechanics by Prof Richard Baker from University of Salford)
- http://www.acpohe.org.uk/ The Association of Chartered Physiotherapists in Occupational Health and Ergonomics

Attendance to classes:

The University believes that faculty members make a significant contribution to the development of students and, as a result, a student who is not consistent in class attendance is missing a major part of the educational experience and the learning outcomes. Students are therefore expected to maintain regular class attendance. Being late to class may be recorded as absence. Absence is also recorded for laboratory or practical sessions as well as for other required work such as trips. Absences in excess of those stated (usually 20%) or failing to take the final examination without a valid and timely excuse will result in either failure or administrative withdrawal and a grade of "F" or "W" respectively will be given. Unusual absences, e.g. for medical reasons, may be excused if the student contacts the faculty member before or during the period of absence. International students are further required by their visa law to attend classes regularly.

Grades:

Letter Grade	*Meaning*	*Numerical Grade*	*Grade Points*
A	Excellent	93-100	4.0
A-		90-92	3.7
B+	Very Good	87-89	3.3

B		83-86	3.0
B-		80-82	2.7
C+	Good	77-79	2.3
C		73-76	2.0
C-		70-72	1.7
D+	Poor but Acceptable	67-69	1.3
D		63-66	1.0
D-		60-62	0.7
F	Failure	0-59	0.0

Lessons Content:

Lessons	Content
1st class	➢ **Introduction to Biomechanics** ➢ **Basic principles of mechanics including terminology** ➢ **Newton's laws of motion** ➢ **Study of human movement** o Osteokinematics o Arthokinematics
2nd class	➢ **Tissue loading** ➢ **Forces, moments, force couples** ➢ **Parameters of tissue loading**
3rd class	➢ **Biomechanics and anatomy of tendons and ligaments** ➢ **Biological and mechanical effect of mechanical load**
4th class	➢ **Biomechanics and anatomy of Bone** ➢ **Biological and mechanical effect of mechanical load**
5th class	➢ **Biomechanics and anatomy of articular cartilage** ➢ **Biological and mechanical effect of mechanical load**
6th class	➢ **Biomechanics and anatomy of intervertebral disc** ➢ **Biological and mechanical effect of mechanical load**
7th MIDTERM EXAM	➢ **Midterm written exam**
8th class	➢ **Biomechanics and anatomy of nerves** ➢ **Biological and mechanical effect of mechanical load**
9th (practical)	➢ **Biomechanics of muscles** ➢ **Assessment of muscle force, torque and work using isokinetic dynamometry (practical)**
10th (theory)	➢ **Human Gait** ➢ **Normal gait parameters**

	➢ **Pathological problems of gait**
11th Class (practical)	➢ **Practical on quantitative gait analysis in the gait analysis lab** ○ **Stages of the process** ○ **Typical results** ○ **Introduction to analysis and reporting**
12th class	➢ **Basic principles of ergonomics**
13th class (practical)	➢ **Practical on workstation assessment and the associated ergonomic interventions**
14th FINAL EXAM	➢ **Final written exam**