

Course Number: 28904

Course Name: Biomechanics of Musculoskeletal System

Course Type: Theory
Prerequisite: Nothing
Level: Graduate
Group: Applied mechanics

Type & Max Unit: Constant 3
Corequisite: Nothing.
First Presentation: 2013-2
Last Edition: 2016-2.

Objectives:

The main goal of this course is to describe the functions of human musculoskeletal system in order to understand the basic biomechanical principles of movement formation. The experimental methods for acquisition of motion data are studied and the analytical methods for forward and inverse analysis of the kinematics and dynamics of human movements are presented. Also, the basics of tissue modeling and characterization are introduced and the mechanical properties and functions of the musculoskeletal tissues are presented.

Topics:

- **Introduction:** Definition of Musculoskeletal Biomechanics, Terminology of Directions and Motions, Human Joints.
- **Skeletal Modeling:** Link Segment Models, Kinematic and Force Data Acquisition, Kinematic and Dynamic Analysis, Inverse and Forward Dynamics Problems.
- **Gait Analysis:** Gait Cycle, Spatio-temporal Characteristics, Kinematic and Kinetic Characteristics.
- **Musculoskeletal Modeling:** Structure of Musculoskeletal Models, Methods of Analysis, Inverse and Forward Simulations, Subject-Specific Modeling.
- **Tissue Mechanics:** Constitutive Equations, Viscoelastic Characteristics, Structure and Properties of Connective Tissues.
- **Tendon and Ligament:** Structure, Mechanical Properties, Biomechanical Behavior, Injuries and Treatments.
- **Bone:** Structure, Mechanical Properties, Biomechanical Behavior, Bone Remodeling, Injuries and Treatments.
- **Auricular Cartilage and Synovial Joint:** Structure, Mechanical Properties, Biomechanical Behavior, Lubrication Mechanisms, Injuries and Treatments.
- **Muscle:** Structure, Types of Muscular Contraction and Work, Parameters Affecting Muscular Force Generation, Modeling of Muscle's Function.

References:

- 1- Benno M. Nigg and Walter Herzog, *Biomechanics of the Musculo-skeletal System*, 3rd Edition, John Wiley & Sons Inc, 2007.
- 2- David A. Winter, *Biomechanics and Motor Control of Human Movement*, 4th Edition, John Wiley & Sons Inc, 2009.
- 3- Don B. Chaffin, Gunnar B.J. Andersson, Bernard J. Martin, *Occupational Biomechanics*, 4th Edition, John Wiley & Sons Inc, 2005.
- 4- Paul Allard, Ian A.F. Stokes and Jean-Pierre Blanchi, *Three-dimensional analysis of human Movement*, Human Kinetics, 1995.