SG2804 Biomechanics of human movement, 7.0 hp 2015

Welcome to the undergraduate course in Biomechanics of Human Movement at KTH! This document describes the course aims, teaching activities and the basis for grading. The examination will consist of a series of homework projects and a final group project (written reports and oral presentations).

What is Biomechanics of human movement?

Biomechanics is a large, and ever-growing field that broadly can be defined as applying the use of mechanics to study living systems. Many different definitions have been proposed, covering topics as wide as fluid flow, tissue engineering, joint modeling, *in vivo* measurements, etc. For this course, we can apply Hay's definition (1973):

> *Biomechanics is the science that examines forces acting upon and within a biological structure and effects produced by such forces*

wherein forces include internal forces or external forces, which must be measured or modeled accurately, and may be attributed to movements of segments or tissue deformation. The study of biomechanics of human movement may include the mechanics that produce movement, the analysis of movement and forces, prediction of movement, etc.

This course

This course will focus on movement of the human body and accompanying forces, fundamentals of motion production, analysis, and modeling. The course focuses first on the anatomy and physiology of the human muscle-force system, then on biomechanical applications involved in human movement. From this foundation, the course will focus on methods to analyze biomechanical problems, including kinematics and kinetics of movement and the muscle force system. Relevant topics requiring such analyses will be discussed. Emphasis is placed not only on computation, but also on interpretation and critical evaluation of results.

Objectives

This course is aimed towards upper level undergraduates and masters students.

After the course, the student should be able to:

- Apply principles of classical mechanics to the study of human motion
- Describe motion with precise, well-defined mechanical and anatomical terminology
- Describe the internal and external forces acting on the body during typical human activities
- Understand how muscle actions control movements
- Model muscle activation and movement
- Understand the methods and limitations of different experimental and analytical techniques used

Instruction

Instruction will be in the form of 2-3 lectures per week, a motion lab visit, and computer labs.

Prerequisites

Students are expected to have complete courses in basic mechanics and dynamics. No previous coursework in anatomy or physiology is required.

Literature

The course book will be:

Biomechanics Basis of Human Movement, 4th ed, by Joseph Hamill, Kathleen M. Knutzen, and Timothy Derrick, ISBN: 9781451194043 or 9781451194043. This book may exist in 3rd edition also, which will be fine, but *the chapter review questions are different!*

No one book covers all topics unfortunately, so I'm including a list of other recommended literature, which can either be borrowed from me for short periods or borrowed from libraries. Hamill & Knutzen has only basic mechanics, but an excellent overview of functional anatomy, and is one of my favorite reference books. Nigg & Herzog covers many topics, but with a major exception of motion and functional anatomy, and is not easily read. Robertson et al is good for experimentalists and researchers, but has very little introduction to the area. Some other complementary reading assignments may be suggested.

- Research Methods in Biomechanics, by D.G.E Robertson, G.E. Caldwell, J Hamill, G. Kamen, and S.N. Whittlesey
- Biomechanics and Motor Control of Human Movement, 4^{th} Ed, by David Winter
- Biomechanics of the Musculo-skeletal system, 3^{rd} Ed. edited by B. M. Nigg & W. Herzog
- Kirtley: Clinical Gait Analysis – Theory and Practice
- Nigg, MacIntosh & Mester: Biomechanics and Biology of Movement
- Nordin & Frankel: Basic Biomechanics of the Musculoskeletal System, 3rd Ed

Software

The open source program OpenSIM version 3.2.0 from SimTK will be used in several assignments. It is a free, open-source software.

Course Evaluations

At the end of the course, a written evaluation will be distributed.

Course Staff

The course is given by the department of mechanics at KTH Engineering Sciences, with guest lectures from Karolinska University Hospital & Institutet

Organizer/Main instructor:	Lanie Gutierrez-Farewik	lanie@kth.se	790 7719
Assistant:	Ruoli Wang	ruoli@kth.se	790 6801

Contact

The course page is on KTH Social.

Schedule

We have 2-3 lecture times per week. Most weeks, we will have an additional meeting, consisting of a lecture, a lab visit to the Motoriklab at Karolinska University Hospital or to a computer lab in the B-building for OpenSIM tutorials. Ruoli Wang will hold a few lectures and the computer labs.

Examinations

There are 4 assignments as ‘homework’ and one final project, all to be performed in a group of about 3 students.

Homework projects/assignments. Assignments will be given nearly every week (total 4). Some assignments are larger, some are smaller. Each assignment has a due date one week later and all are mandatory. This due date is expected to be held unless we have made a previous agreement. I hope to only make exceptions for travel, illness, etc, and for the majority of participants to have completed all course requirements directly after the final meeting.

Homework assignments are to be submitted in report or presentation form, with emphasis placed on synthesis and interpretation of results, not simply on the computation. Programming code is to be attached as an appendix when relevant.

Final project. The project will also be completed in groups. I will create the groups, but am open to suggestions.

Grading: For each assignment, between 0-5 points will be given, depending on the ambition achieved and the assignment quality. The final project will be graded between 0-10 points, i.e. it counts as a double homework assignment. This makes a total of 30 points of which 13 are required to pass the course. Grading:

13-15	16-18	19-22	23-26	27-30
E	D	C	B	A