TMMS07 Biomechanics

Course Information 2017

General Information

The course aims to give the student an understanding of fundamental principles in biomechanics by applying concepts and methods from engineering, physical sciences and mathematics to problems in living structures and organisms. The focus is on hard and soft mammalian tissue. Hard tissues are, mainly, bone while soft tissues include blood vessels, cerebral tissue, ligaments, muscles, tendons etc.

The course includes 16 lectures and 6 tutorials. The exam comprises three to four hand-in assignments.

Examiner

Jonas Stålhand (jonas.stalhand@liu.se)

Course Administration

Anna Wahlund (anna.wahlund@liu.se)

Lecturers

	Topic	**e-mail**
Lars Johansson (LJ)	Hard tissues	lars.johansson@liu.se
Jonas Stålhand (JS)	Soft tissues	jonas.stalhand@liu.se

Course Homepage

Please note that the most of the communication is done using the Solid Mechanics dedicated website. The internet adress is:

`http://www.solidmechanics.iei.liu.se/Examiners/Courses/Master_Level/tmms07/`

Course Literature

The course is based on the material covered during the lectures. The book by Humphrey and Delange (2004) covers most of the material and is a good introduction to biomechanics. Please note that other books, scientific articles, or internet pages can also be used. The keen student should have no problem substituting the suggested literature for other material available through the University Library. See also the reference list at the end.

Examination

The examination comprises hand-in assignments which will be distributed at the end of the course. Each assignment is to be reported in terms of a written report. Use a word processor, e.g., Microsoft Word, LaTeX, or LibreOffice Writer, with font size 11-12pt and normal margins when compiling the reports.

Upload the reports as PDF documents to the correct map on the course page in Lisam. Note carefully that the reports may be submitted to Urkund for automatic authenticity verification. Dead-line for submission is **13 January, 2018**. Read the instructions for each assignment carefully since additional requirements may apply!

The student must fulfil the following **three requirements to pass the exam**:

- a minimum of 40% of the score on each assignment,
- a minimum of 50% of the total score, and
- submit all reports before dead-line.

Grades are awarded according to:

ECTS C (3): 10–13p, ECTS B (4): 14–17p, ECTS A (5): 18–20p.

Students who fail the exam must take a new exam which is given on request twice a year in March and August. Please contact the examiner via e-mail well in advance for a new assignment.

All assignments are to be solved and reported individually. Cheating and plagiarism is not permissible. To use or copy codes, results, text, et cetera from other students or from the internet without citing the source is considered as an attempt to deceive during examinations and the student will be reported to the Disciplinary Board at Linköping University. For further information regarding cheating and plagiarism, please consult the University's web pages on disciplinary measures (`http://www.student.liu.se/studenttjanster/lagar-regler-rattigheter/disciplinarenden?l=en`), or contact the examiner.

Lecture Plan

Class	Lecture (Le) Tutorial (Tu)	Subject	Lecturer
1	Le	Introduction to Biomechanics	JS
2	Le	Introduction to Hard Tissues	LJ
3	Le	Uniaxial Tension	LJ
4	Le	Simple Stress States	LJ
5	Le	The Stress Matrix	LJ
6	Tu		LJ
7	Le	Introduction to Soft Tissues	JS
8	Le	Soft Tissue 1D Deformation	JS
9	Le	Soft Tissue 1D Conservation Laws: I	JS
10	Le	Soft Tissue 1D Conservation Laws: II	JS
11	Le	Soft Tissue 1D Constitutive Equations	JS
12	Tu		JS
13	Le	Viscoelastic Materials	LJ
14	Le	Biphasic Materials	LJ
15	Le	Soft Tissue 3D Deformation	JS
16	Tu		LJ
17	Le	Soft Tissue 3D Stress and Equilibrium	JS
18	Le	Soft Tissue 3D Constitutive Equation	JS
19	Le	Soft Tissue 3D Examples	JS
20	Tu		JS
21	Tu	Questions and answers	LJ/JS
22	Tu	Questions and answers	LJ/JS

References

Ethier CR, Simmons CA (2007) *Introductory Biomechanics. From Cells to Organism.* Cambridge University Press, Cambridge

Hozlapfel GA(2001) Biomechanics of Soft Tissue. In: J Lemaitre (ed.), *The Handbook of Materials Behavior Models*, Volume III, Multiphysics Behaviors, Chapter 10, Composite Media, Biomaterials. Academic Press, Boston, pp 1049-1063. (A copy of the article can be downloaded from the author's homepage: `https://www.biomech.tugraz.at/index.php/puplications`)

Holzapfel GA, Gasser TC, Ogden RW (2000) A new constitutive framework for arterial wall mechanics and a comparative study of material models. *J. Elasticity* 61: 1–48

Humphrey JD, Delange SL (2004) *An Introduction to Biomechanics. Solids and Fluids, Analysis and Design.* Springer Science+Business Media, New York

Klarbring A (2006) *Models of Mechanics.* Springer, Dordrecht, The Netherlands

OOmens C, Brekelmans M, Baaijens F (2009) *Biomechanics. Concepts and Computation.* Cambridge University Press, Edinburgh

Zamir M (2005) *The Physics of Coronary Blood Flow.* Springer Science+Business Media, New York