Course information for

Tissue biomechanics BMEN10

Course objectives

The aim of the course is to deepen the knowledge in biomechanics and mechanobiology of the skeletal tissues (bone, articular cartilage, tendons and ligaments) and to understand the pathomechanics of injury, adaption and degenerative changes with aging. Moreover, the course aims to provide an insight into current biomechanical research of skeletal tissues.

Responsible teacher: Hanna Isaksson (hanna.isaksson@bme.lth.se), Dept of Biomedical Engineering, BMC-D13, room D1341a, Telephone: 046 222 1749

Teaching assistant: Anna Gustafsson (**AG**) (anna.gustafsson@bme.lth.se), Elin Törnquist (**ET**) (elin.tornquist@bme.lth.se), Thomas Notermans (**TN**) (thomas.notermans@bme.lth.se), Joeri Kok (**JK**) (joeri.kok@bme.lth.se), available at BMC-D13, rooms D1310b, D1312b and D1314b.

Office hours: See preliminary hours in schedule, to be arranged in class. At least one session after each laboratory task.

Course literature:

- Handouts: Lecture notes, research articles, book chapters and example problems.
- Assignments: One literature study assignment and two experimental and numerical laboratory assignments.
  Handouts and assignments will be available on the course homepage:
  http://bme.lth.se/course-pages/tissue-biomechanics/tissue-biomechanics/

Schedule: Please see detailed schedule on next page/under schedule.

Types of teaching: Traditional lecturing is mixed with problem solving and group exercises. Two sets of experimental and numerical laboratory assignments are included. All sessions are scheduled.

Examination: The examination of the course consists of one compulsory assignment and two laboratory reports. The assignment is performed in *groups of 2-4 students*. It includes choosing a research topic, reading, analysing and presenting the topic. It is handed in as a short summary (max 3 pages) and is presented to the other students orally at a seminar (15 + 5 min). The two laboratory parts are divided into one experimental and one numerical laboratory exercise each. For each of the two laboratory sets, one report from both numerical and experimental exercises is completed and handed in *individually* (max 10 pages).

The assignments and each of the laboratory report receive written feedback, and has to be approved for passing the course with grade 3. Assignment 1 can maximum give 20 points each, and the laboratory reports can each give a maximum of 40 points. On each assignment, 50% is required for passing the course with grade 3. The final grade of the course is based on the total number of points: Fail < 50 p. Grade 3 51-69 p. Grade 4 70-89 p. Grade 5: 90-100 p.

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HT-2018

Preliminary schedule

W	Day & time	Place		Theme	Assignments
1	Mon 5/11 8-10	E:1328	L1	Course introduction, Bone biology, **HI**	
	Tue 6/11 10-12	A:A	L2	Bone mechanics, calculations, **HI**	
	Thu 8/11 10-12	E:1328	L3	*Practical lab information*, calculations **AG**, **HI**	Hand out: Bone lab instructions
2	Mon 12/11 8-10	E:1328	L4	Degenerative bone diseases Remodelling & mechanobiology, **HI**	
	Tue 13/11 10-12	A:A	L5	Cartilage biology and mechanics, **HI**	
	Tue 13/11 13-18	Lab	*Exp*	*Lab bone, Experimental (group 1-3)* **ET, AG**	
	Fri 16/11 8-12	Lab	*Exp*	*Lab bone, Experimental (group 4-6)* **ET, AG**	
3	Mon 19/11 8-10	E:1328	L6	Mechanical models of cartilage, calculation examples, **HI**	Choose A1
	Mon 19/11 10-13	*Ingrid's office*		*Office hours (Lab)* ***ET***	
	Wed 21/11 8-12 / 13-17	*E:Ravel*	*Num*	*Lab bone, Finite element (am or pm)* **JK, AG**	
	Thu 22/11 10-12 / 13-15	*E:Ravel*	*Num*	*Lab bone, Finite element (am or pm)* **JK, AG**	
4	Mon 26/11 8-10	E:1328	L7	Biomaterials for hard tissues, **HI**	Due: plan A1
	Tue 27/11 10-12	A:A	L8	Biomaterials for soft tissues, **HI**	Get feedback on A1-plan
	Tue 27/11 13-15	*Ingrid's office*		*Office hours (Lab)* ***JK***	
	Thu 29/11 10-12	E:1328	L9	Degenerative joint diseases, cartilage regeneration strategies, **XX**	
	Fri 30/11 10-12	*Ingrid's office*		*Office hours (A1)* ***HI***	
5	Mon 3/12 8-10	E:1328	L10	Tendons and ligaments, biology and mechanics, **HI**	Due: Lab report Bone Hand out: Tendon lab instructions
	Tue 4/12 10-12	A:A	S	*Student presentation*, **HI**	Due: Oral A1
	Thu 6/12 10-12	E:1328	S	*Student presentation*, **HI**	Due: Oral A1; Written A1
6	Mon 10/12 8-10	E:1328	L11	Total hip replacement surgery, **GF**	
	Wed 12/12 13-17	Lab	*Exp*	*Lab tendon, Experimental (group 1-3)* **ET, AG**	
	Fri 14/12 13-17	Lab	*Exp*	*Lab tendon, Experimental (group 4-6)* **ET, AG**	
7	Mon 17/12 8-10	E:1328	L12	Extra time	Get feedback on A1 and bone lab report
	Mon 17/12 10-12	*Ingrid's office*		*Office hours (Lab + A1)* ***ET, HI***	
	Thu 20/12 8-12	*E:Ravel*	*Num*	*Lab tendon, Finite element (group 1-3)* **TN, AG**	
	Thu 20/12 13-17	*E:Ravel*	*Num*	*Lab tendon, Finite element (group 4-6)* **TN, AG**	
	Fri 21/12 10-12	E:1328	L 13	Summary, feedback and evaluation. Research at LU & MSc projects, **SLC**	
	Fri 21/12 13-15	*Ingrid's office*		*Office hours (Lab) TN*	
	15/1 - 2019			Hand-in final lab-report by email	Due: lab report tendon

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Type: L - Lecture S - Student presentations
Exp - Experimental lab Num - Numerical finite element lab

Guest lecturers:

- Hip replacement surgery: **Gunnar Flivik (GF)**, Orthopedic Surgeon, Skåne University Hospital. Attending lecture is compulsory. If not, a one-page summary should be written about the topic.

Compulsory assignments (examination used for grading)

Assignment 1: Research topic
Reading about a current research topic of your choice.

Choose topic/group 19/11
Hand in plan: 26/11
Due: Oral 4/12 or 6/12
Due: Written 6/12

Students gather in groups of 2-4 people and choose a research topic. You need to find at least 5 research articles about the topic and thoroughly read them. The topic is then presented orally during 15 + 5 min in front of the rest of the class, and a written summary is handed in per group (3 pages).

20% of grade

Laboratory 1, bone: ***Due: 3/12***

Practical experimental and numerical exercises related to bone mechanics.

Three-point bending test of a rat femur will be conducted in the biomechanics laboratory, followed by a practical finite element exercise where you should mimic your experimental test.

One report is completed, where you combine both exercises, including reflection and conclusions, as well as discussion of necessary assumption regarding experimental testing and the numerical modelling.

Also includes calculation problems related to bone mechanics and elasticity.

Handed in individually.
40% of grade

Laboratory 2, soft tissues: ***Due: 15/1 - 2019***

Practical experimental and numerical exercises related to tendon mechanics.
Tensile test of a rat tail tendon will be conducted in the biomechanics laboratory, followed by a practical finite element exercise where you should mimic your experimental test.

One report is completed, where you combine both exercises, including reflection and conclusions, as well as discussion of necessary assumption regarding experimental testing and the numerical modelling.

Also includes calculation problems related to soft tissues, e.g. viscoelastic models

Handed in individually.

40% of grade