ME 208 Biomechanics II – Spring 2008

Time and Location: MWF 10:10-11:00, Votey 223
Instructor: James C. Iatridis, Ph.D.
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Office Hours: MW 11:00-12:00, or by appointment

Text: "Basic Orthopaedic Biomechanics and Mechano-Biology, 3rd Edition" by VC Mow & R Huiskes, Lippincott-Raven, 2005. ISBN: 0-7817-3933-0
Other Texts:
"Biomechanics – Mechanical Properties of Living Tissues." Y.C. Fung, 2nd Edition, Springer-Verlag, 1993.
"Creep and Relaxation of Nonlinear Viscoelastic Materials." WN Findley, JS Lai, K Onaran, Dover Publications, 1976
"Tissue Mechanics" SC Cowin, SB Doty, Springer, 2007

Other references: Several articles and handouts will be provided. Students are expected to know how to perform literature searches using medline (http://www.pubmed.gov) and to access journals from the Dana library as necessary.
Prerequisite: ME 207, or instructor permission

Computer Resources & Requirements:
Look for updates to the course schedule and announcements at: http://www.cems.uvm.edu/~iatridis/me208
*The ability to program in MATLAB, Mathematica, Mathcad, or strong proficiency using macros in Microsoft Excel is expected. A MATLAB tutorial can be scheduled if necessary.

Objectives:

Introduction to biomaterials and the mechanical behavior of bioviscoelastic fluids or solids.
Credit hours: 3

Proposal Project (60% of grade)
The largest aspect for student assessment requires is preparation of a grant proposal, in a manner similar to a research biomedical engineer in the 'real world,' characterized by:
1. formulation of hypotheses,
2. design of devices and experiments to test these hypotheses,
3. application of quantitative methods of analysis to the data that the experiments provide,
4. preparation of proposals to obtain the necessary funding to perform the study, and
5. preparation of manuscripts for publication.

Draft hypotheses/literature review – 5% of final grade (Due Feb 8)
Each student will propose a potentially testable hypothesis related to some aspect of biomechanics together with a justification for why the hypothesis is important (up to 2 pages, 12-point, double-spaced text including a single diagram) and a literature review (up to 4 pages of 12-point double-spaced text including diagrams, not including a maximum of 20 references listed separately).

Draft research plan report – 5% of final grade (Due Mar 21)
Each student will submit a research plan for the testing their proposed hypothesis. The plan must contain both experimental and theoretical (analytical) methods, experimental protocols, and expected results (up to 6 pages of 12-point double-spaced text including diagrams).

Final Report/Proposal – 40% of final grade (due May 5)
Each student will submit a final project report in the form of a grant proposal based on the NIH/NSF format as follows: A. Specific Aims (1 page), B. Background and Rationale (5 pages), C. Description

of the preliminary data that should be collected prior to submission to a granting agency (4 pages), D. Experimental plan (6 pages), and E. References (up to 25).

Final Presentation – 10% of final grade (Presentations during final class week & during final exam slot)
Each student will make a 25 min formal presentation of their proposal to the rest of the class.

Journal club presentation (15% of grade)

The student will be assigned and/or choose a paper with guidance from Dr. Iatridis. The student will learn all aspects of this paper and become an expert in the topic. This will require reading supportive papers, background literature, and in some cases contacting the corresponding author. The student will provide a full 50 minute lecture on the topic, leaving ample time for questions and discussion.

Homework & Take-home exam (25% of grade)

- Homework will be assigned regularly in the first half of the class.
    - Group Collaboration on the homework is acceptable; however, each student is required to submit their own solution set which is to be written with their own explanations.
    - Format. Solution sets must be neatly written and documented. Explanations of problem-solving approaches and key assumptions made should be provided.
    - Due Dates. At the time at which it is assigned, a deadline for the homework will also be given. An assignment is considered on-time provided that it is in my mailbox or under my office door prior to my arrival (usually by 8-8:30 am) on the day following the due date.
- A take-home exam will also be assigned which is intended to be an individual exercise
- The class is small and students are strongly encouraged to participate in class!

Overall Grading Summary:

HW & take-home exam	25%
Journal club presentation	15%
Literature review/hypotheses	5%
Draft research plan	5%
Final report/proposal	40%
Final Presentation	10%
	100%

week	date	Topic	sub-topic	References/Comments
1	14-Jan	Introduction	Syllabus/Intro to tissue mech/viscoelasticity	
1	16-Jan		Laplace transform and direct methods of ODE solutions	
1	18-Jan	Spine Biomechanics	Iatridis Kyoto presentation	
2	21-Jan	MLK Day -- Holiday		
2	23-Jan	Viscoelastic testing/modeling	Maxwell fluid & Kelvin solid Solutions	Michalek
2	25-Jan		Experimental configurations	Michalek
3	28-Jan	Viscoelasticity 2	Mechanical testing demo/Spine bioengineering lab tour	Michalek/Barbir
3	30-Jan		Dynamic testing	Assignment 1 Due
3	1-Feb		Boltzmann superposition/Generalized Maxwell Model	
4	4-Feb	Experimental Modeling	Matlab solutions to viscoelasticity problems	
4	6-Feb		nonlinear regression/stretched exponential	
4	8-Feb		Viscoelasticity journal club -- JCI Iatridis et al., J Biomech,	Assignment 2 Due -- proposal hypotheses
5	11-Feb	Quasilinear viscoelasticity	Quasi-linear viscoelasticity	
5	13-Feb		QLV2	
5	15-Feb		Viscoelasticity journal club 2	Bates, ABME 2007
6	18-Feb	Holiday	President's Day	
6	20-Feb	Biphasic	Intro/permeation	
6	22-Feb		PDE solutions/confined compression	
7	25-Feb		biphasic example 2	
7	27-Feb		biphasic journal club	Johannessen et al., Evans et al.
7	29-Feb	**exam**	**take-home exam planned**	
8	3-Mar	ORS Meeting	Gait dynamics	Coleman lecture
8	5-Mar	ORS Meeting	Lab tour -- Microscopy imaging center	meet @ HSRF- Massa coordinates
8	7-Mar		biphasic closure/no class?	
9	10-Mar	Spring Break	No Class	
9	12-Mar	Spring Break	No Class	
9	14-Mar	Spring Break	No Class	
10	17-Mar	Triphasic	transport/swelling	
10	19-Mar		electrokinetic phenomena	
10	21-Mar		Transport journal club -- frap, Leddy et al., 2003 & 2006	**Prop Res Plan Draft Due**
11	24-Mar	Cell Mechanics & mechanobiology	intro	
11	26-Mar		micropipette & AFM	
11	28-Mar		Cell mechanics, Darling et al., 2006	
12	31-Mar	Tissue Engineering	tissue engineering triad	Korecki lecture
12	2-Apr		Cell sources	Korecki lecture
12	4-Apr		biomaterials and processing techniques	Korecki lecture
13	7-Apr		Tissue Engineering Journal Club -- maturation	Mauck et al., 2006
13	9-Apr		Tissue Engineering Journal Club2 -- electrospinning	Li et al., 2006
13	11-Apr	Mechanotransduction in fascia	Langevin lecture	
14	14-Apr		Langevin lab tour	ve and/or ultrasound elastography
14	16-Apr		Mechanotransduction journal club	Langevin et al.papers
14	18-Apr	Imaging	MRI physics	Michalek lecture
15	21-Apr		quantitative MRI/dGEMRIC	
15	23-Apr		functional MRI	
15	25-Apr	**Class presentations**	**Final Presentations**	
16	28-Apr	**Class presentations**		
16	30-Apr	**Class presentations**		
Final Exam Date Monday May 5th; 8:00-11:00AM			Proposal Assignment DUE	