EGM 5584: Biomechanics of Soft Tissues
Syllabus -- Fall 2011 -- Section 7039

1. **Catalog Description:** Introduction to solid and fluid mechanics of biological systems. Rheological behavior of materials subjected to static and dynamic loading. Mechanics of cardiovascular, pulmonary, and renal systems. Mathematical models and analytical techniques used in biosciences.

2. **Pre-requisites:** EGN 3353C and EGM 3520

3. **Course Objectives:**

4. **Instructor:**
   Thomas E. Angelini
   - Office location: 222 MAE-B
   - Telephone: 392-6438
   - E-mail address: t.e.angelini@ufl.edu
   - Office hours: TBD

5. **Meeting Time:** 9:35am, MWF, 238 MAE-B

6. **Recommended texts** (NOT required):
   - Biological Physics, Philip Nelson
   - Molecular Biophysics, Michel Daune
   - Mechanics of Motor Proteins and the Cytoskeleton, Jonathan Howard
   - Intermolecular and Surface forces, Jacob Isrealachvili

7. **Course Outline and Schedule:**

   **Introduction: biological materials**
   Dates: 8/22, 8/24
   1. Movies: membranes, filaments, networks, cells
   2. Cells and cell pieces: nucleus, cytoskeleton, membrane, ECM
   3. Biochemistry: nucleic acids, amino acids, the peptide bond, amphiphilic molecules, protein structure
   4. Building a cell from these materials

   **Biopolymer Mechanics**
   Dates: 8/26, 8/29, 8/31, 9/2, 9/7, 9/9, 9/12, 9/14, 9/16, 9/19, 9/21
   1. Random coil / gaussian chain polymers
   2. Important concepts: MSD, Vrms
   3. Worm-like chain, persistence length, thermal bending
   4. Analysis of thermally driven polymer bending
   5. Compressing, bending, buckling.

   **Project 1:** due 9/26

   **Membrane Mechanics**
   Dates: 9/26, 9/28, 9/30, 10/3, 10/5, 10/7, 10/10, 10/12, 10/14, 10/17, 10/19, 10/21, 10/24, 10/26
   1. Lipids and Membranes Introduction
   2. Schulman-Montagne condition in amphiphilic self assembly
   3. Curvature in Membrane Systems
   4. Gauss-Bonnet theorem
5. Microscopic origin of elasticity
6. Membrane elasticity
7. Relating measurements to theory

Project 2: due 10/28

Single Cell Mechanics
Dates: 10/28, 10/31, 11/2, 11/7, 11/9, 11/14, 11/16, 11/18,

1. Entropic elasticity of semi-flexible networks
2. Force-extension curve for short semi-flexible filaments
3. Phenomenology of cell migration
4. Traction Force microscopy (MSM)

Project 3: due 11/21

Tissue Mechanics
Dates: 11/21, 11/23, 11/28, 11/30, 12/2, 12/5, 12/7

1. Continuum mechanics of monolayers
2. Monolayer Stress Microscopy (MSM)
3. Physiological principle of minimum work

Final Project: due on date of final.

8. Attendance and Expectations: Attendance is mandatory. Excused absences will be given for documented medical reasons, UF related travel or job interview travel. Documentation must be in the form of a doctor’s note, or letter from the sponsor of the travel. During class, cell phones must be turned off.

9. Assessment Methods and Grading:
There will be three term projects and a final project; the resulting four scores will be averaged to determine your final grade. The final project is due at the scheduled final exam time and date.

10. Grading Scale:

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>93 – 100</td>
<td>A</td>
</tr>
<tr>
<td>90 – 92.9</td>
<td>A-</td>
</tr>
<tr>
<td>87 – 89.9</td>
<td>B+</td>
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<tr>
<td>83 – 86.9</td>
<td>B</td>
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<tr>
<td>77 – 79.9</td>
<td>C+</td>
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<tr>
<td>73 – 76.9</td>
<td>C</td>
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<tr>
<td>67 – 69.9</td>
<td>D+</td>
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<tr>
<td>63 – 66.9</td>
<td>D</td>
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<tr>
<td>59.9 – 0</td>
<td>F</td>
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</tbody>
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11. Make-up Policy: No late assignments will be accepted. Makeup exams are not normally allowed. If you cannot attend an exam or cannot meet a due date, you must contact the instructor prior to the exam or due date. Arrangements will be made for students on a case by case basis. (Failure to contact the instructor prior to the exam or assignment prior to the due date will result in a zero on that exam/assignment.)

12. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.
13. **Accommodation for Students with Disabilities** – Students requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

14. **UF Counseling Services** – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

   - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
   - Career Resource Center, Reitz Union, 392-1601, career and job search services.

15. **Software Use** – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.