SYLLABUS: BMEN 432/632 MOLECULAR AND CELLULAR BIOMECHANICS
Spring, 2011, Department of Biomedical Engineering
TR 12:45PM-2:00PM, ZACH 333A
Professor Wonmuk Hwang, Ph.D (hwm@tamu.edu)

Course Description:

Biomechanics at the molecular and cellular level differs from macroscopic level biomechanics, as it is a discrete many-body problem where thermal fluctuation plays an important role. These nanostructured biosystems have evolved to perform an amazing range of functions and adaptability. This course deals with biomolecular assemblies that play structural and dynamical roles in subcellular to cellular level processes, with an emphasis on quantitative understanding. Relevant biological background and phenomenology will also be covered.

Prerequisites: Basic mathematical skills (differential equations) and knowledge of general physics are expected. Experience with statistical mechanics and cell biology would be helpful, although not required.

Course Objective: Develop conceptual and theoretical basis for describing mechanical phenomena at the molecular level. Understand the self-assembly or organizational behaviors of biomolecules and cells in terms of the underlying physical interactions.

Instructor: Wonmuk Hwang, Ph.D.
Room: Zachry 335M
Email: hwm@tamu.edu
Tel: 458-0178
Office hours: To be determined during the first day of class.

Textbook: Jonathon Howard, Mechanics of Motor Proteins and the Cytoskeleton (Sinauer Associates, 2001). In addition, reading materials will be distributed occasionally.

Other useful references:
1. Michel Daune, Molecular Biophysics: Structures in Motion (Oxford University Press, 1999)

Grading:
Midterm 35%
Final 35%
Homework & Participation 30%
Final grades will be given separately between 432 and 632 sections.

Course Outline (28 lectures in total):
1. (1/18) Scales & forces in biology
2. (1/20) Review of equilibrium statistical mechanics I
3. (1/25) Review of equilibrium statistical mechanics II
4. (1/27) Role of force in chemical & conformational equilibria
5. (2/1) Electrostatic interactions in physiological media
6. (2/3) van der Waals interaction between macromolecular surfaces
7. (2/8) Water: properties and hydrophobic effects
8. (2/10) Water: hydrophilic effects. Protein folding in a nutshell
9. (2/15) Continuum description of Brownian motion
10. (2/17) Solution of diffusion equation from a point source
11. (2/22) Diffusion as a random walk process
12. (2/24) Overview of biofilament structure & function
13. (3/1) Midterm Review
14. (3/3) Midterm Exam
15. (3/8) Biophysical Society Meeting (no class) - Subject to change
16. (3/10) Description of rod-like polymers: bending
17. (3/22) Buckling instability and behavior of a cantilevered beam
18. (3/24) General case for the mechanical equilibrium of rodlike filaments
19. (3/29) Dynamics of rodlike filaments in solution
20. (3/31) Flexible polymer: freely-jointed chain model, persistence length
21. (4/5) Worm-like chain and Kuhn length
22. (4/7) Entropic elasticity
23. (4/12) Actin polymerization
24. (4/14) Effect of nucleation in self-assembly
25. (4/19) Polymerization-driven cell motility
27. (4/26) Motor protein: Brownian ratchet vs. power stroke mechanism
28. (4/28) Course overview

Americans with Disabilities Act (ADA)
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Cain Hall, Room B118, or call 845-1637. For additional information visit http://disability.tamu.edu

Academic Integrity
For additional information please visit: http://www.tamu.edu/aggiehonor
“An Aggie does not lie, cheat, or steal, or tolerate those who do.”