

## **Physics of Biopolymer (0321-4824-01)**

### Teacher contact information:

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Meeting day and hour: Thursdays 8:30-9:30 and by personal scheduling

Course schedule: Monday 11-13, Tuesday 09-10

### Course obligations:

- **Bold chapters** are to be read prior to relevant classes. Other chapters are optional reading.
- Additional mandatory research papers readings will be given during the semester.
- An exam will be held in the end of the semester which will be accounted to 75% of the final score. One must pass the exam in order to pass the course
- Each student will make a short presentation (20 minutes) regarding a research paper describing the use of biophysical technique in biopolymer research and the relevant questions it answered. The presentations will be given at the end of the semester. The presentation will account for 25% of the final grade in the course.

### Syllabus and reading materials:

- I. Introduction: Biopolymer components- amino acids, nucleic acids, lipids, sugars  
**(4) ch. 1**, (6) ch. 2, (3) ch. 1
- II. Forces and interactions in biophysics (EM, VDW, hydration, thermal/entropic, hydrophobic, covalent and H-bonds)  
**(1) ch 1-2** (also ch. 3-9), (4) ch. 2
- III. Salt solutions - PB + PB approximations. Debye Huckel theory, ionization and phase separation  
**(2) ch 6**, (4) ch. 9, (3) ch. 9, (1) ch. 14
- IV. Charged surfaces - Gouy Chapman, correlation effects, fluctuation  
**(1) ch. 14**, (2) ch 4-6
- V. Counter ions condensation, Manning condensation, DLVO theory  
**(1) ch. 13,14,21 (5) ch. 5.2**
- VI. Interacting membranes and complexes - elastic energy and phase behavior  
**(1) ch. 20-21** (3) ch. 11, (4) ch.10, (2) ch. 4,5, (5) ch. 7
- VII. Random walks, diffusion and elasticity of biopolymers  
**(4) ch. 8**, **(3) ch. 8-10**, (2) ch. 3, (3) ch. 9, (6) ch. 6
- VIII. Polyelectrolytes - flexibility and rigidity  
**(4) ch. 9**, (3) ch. 9
- IX. DNA condensation (with ions, lipids, histones, viruses etc)  
**(4) ch. 16**, (3) ch. 10
- X. Cytoskeleton proteins - self-assembly, interactions, phase behavior  
**(2) ch. 8**
- XI. Biophysical structural techniques: Microscopy, FRET, NMR, rheology, X-ray scattering and diffraction, neutron scattering, SPM, EM, SFA, simulation (MC, MD)  
**(4) ch. 12,13**, (2) ch 14-16

Texts Books:

- 1) Israelachvili - Intermolecular and Surface Forces
- 2) Poon and Andelman - Soft-Matter Physics in Molecular and Cell Biology
- 3) Phillips - Physical Biology of the Cell
- 4) Waigh – Applied Biophysics
- 5) Witten & Pincus – Structured fluids

Additional books:

- 6) Nelson, Biological Physics
- 7) Dill & Bromberg - Molecular Driving Forces - Ch.22-33
- 8) Fraser - The New Physics - ch. 16
- 9) Evans & Wennerstrom - The colloidal Domain
- 10) Atkins & de Paula - Physical Chemistry