BASIC INFO AND SYLLABUS (2013)

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WHERE & WHEN: Peterson Hall 103; Tue/Thu 8:00-9:20 a.m.

COURSE GOALS

Gain a basic understanding of the principles of transmission electron microscopy (TEM) and three-dimensional (3D) image reconstruction as applied primarily to the study of biological macromolecules, macromolecular complexes, and small organelles and cells. Knowledge of these principles form a foundation for those who may be interested in obtaining practical experience and training in TEM and 3D reconstruction. Even if you never record a TEM image or compute a 3D reconstruction, the course should help broaden your knowledge about powerful, rapidly evolving tools of structural biology and enable you to critically evaluate research results reported in the scientific literature that rely on the use of these popular technologies.

COURSE FORMAT

1. Lectures on Tuesdays and Thursdays (8:00-9:20 am) from Jan 8 through Mar 14.
2. One or two optional lab "demos" *might* be offered outside of the normal class period (*e.g.* to tour a modern TEM facility) and will provide a means to earn some extra credit.
3. Optional, 1-hour recitation/help sessions will be held on some Fridays (time/place yet to be determined) where students can ask burning questions about lectures or optional homework assignments and to help prepare for exams. This time might also be used to cover certain topics in more depth than possible in class, or that couldn't be covered in class but which are covered in required reading materials.

GRADING

Undergraduate students (those taking CHEM 165 or BIMM 162): There will be one midterm exam (100 pts), a comprehensive final exam (200 pts), and three, two-page written critiques (50 pts each) chosen from six different image processing topics. You may submit up to six critiques, but the final grade will be based on an un-weighted sum of the midterm and final exam plus the three highest scored critiques (for grand total of 450 possible points). There are **NO MAKE-UP EXAMS**.

Graduate students (those taking CHEM 265 or BGGN 262): The rules are essentially the same as for undergraduates except that graduate students must submit four and only four critiques. Hence, the final grade will be based on an un-weighted sum of the midterm and final exam plus the four critiques (for grand total of 500 possible points). In addition, the comprehensive final exam will include questions that differ from those given to undergraduate students and will also include more challenging versions of questions given to the undergraduates. There are **NO MAKE-UP EXAMS**.

CLASS HANDOUTS AND OTHER MATERIALS

Course reading material is posted on the class website at http://cryoem.ucsd.edu. Access to this and additional material requires a username and password provided during the first class meeting. Lecture notes include most of the illustrations that will be shown as Powerpoint presentations. Having access to this should minimize the need for frantic note taking and allow you to listen carefully and concentrate more on understanding the basic principles being presented.

Lecture notes, PowerPoint slides, optional homework, and other supplementary materials (e.g. reference lists) are available as PDF documents on the class website to help solidify your understanding of the topics being discussed. The lecture notes and select literature articles are **required** reading because it is impossible to cover materials in adequate depth during lectures alone.

SYLLABUS (Tentative Schedule)

Date(s)	Lec #	Topic(s)
Jan 8	1	Course introduction; Analogy between light microscopy and transmission electron microscopy
Jan 10	2	Electrons/waves/interference/resolution
Jan 15	3	Optics and electromagnetic lenses
Jan 17	4	Design of the TEM and lens aberrations (Top to bottom description of instrument)
Jan 18		**Optional recitation session (laser demo; review of homework and lectures, etc.)**
Jan 22	5	Design of the TEM and lens aberrations (Continued)
Jan 24	6	Contrast and image formation (electron scattering)
Jan 25		**Optional recitation session (review of homework and lectures, etc.)**
Jan 29	7	Basics of TEM alignment, performance, operation, and image recording
		Other modes of TEM operation – self taught from notes §I.F
Jan 31	8	Overview of specimen preparation (emphasis on cryoTEM); Radiation effects
		Other biological specimen preparation methods – self taught from notes §II.A.2-II.A.5
Feb 1		**Optional recitation session (Help session to prep for midterm exam)**
Feb 5		**Midterm Exam (100pts) – Covers material through Jan 31 lecture**
Feb 7	9	Introduction to image analysis; Sources of noise
Feb 12	10	Crystals, symmetry and diffraction
Feb 14	11	Crystals, symmetry and diffraction (Continued)
Feb 19	12	Fourier processing techniques
Feb 21	13	Fourier processing techniques (Continued)
Feb 22		**Optional recitation session (review of homework and lectures, etc.)**
Feb 26	14	Principles of 3D image reconstruction
Feb 28	15	3D reconstruction of thin 2D crystals
Mar 5	16	3D reconstruction of helical assemblies
Mar 7	17	3D reconstruction of macromolecular complexes with icosahedral symmetry
Mar 8		**Optional recitation session (review of homework and lectures, etc.)**
Mar 12	18	3D reconstruction of macromolecular complexes with no symmetry
Mar 14	19	Electron cryo-tomography of unique specimens, organelles, and cells
Mar 15		**Optional recitation session (Help session to prep for final exam)**
Mar 21		**FINAL EXAM (200pts) – All inclusive, but focuses on 2nd half of course**

OFFICE HOURS: Tues and Thurs 9:30-10:30 am; NSB 4-105 (Baker), 4-316 (Viadiu)

Call or email Drs. Baker or Viadiu, or Irene Acosta for appointments at different times.

PLEASE READ THIS VERY CAREFULLY

- Lectures begin **PROMPTLY** at 8:00 a.m. and end as close to 9:20 a.m. as possible to maximize the learning experience of all participants. As you will see, the time allotted to cover many new concepts is very limited. Being seated and ready to proceed at 8 a.m. sharp will minimize disruptions and be appreciated by all. As an added incentive to those who show up a few minutes early, classes will often be preceded by one or more multiple choice questions that could appear verbatim or in slightly modified form on the graded exams. Such questions will not be posted on the class web site. Other sample questions will also be presented during lectures, and these will be posted on the web site with that day's Powerpoint lecture material.
- As obvious as it sounds, come to class well prepared. For example, complete any assigned reading and be ready with questions, especially if something from a previous lecture or in the class notes needs clarification. An extensive set of practice homework questions will be posted on the class web site and updated regularly. These questions will often mimic those given on exams. Students who take the time to do these problems **regularly** (*i.e.* not wait until right before an exam) are virtually guaranteed to be ready to perform well on the exams.
- Please turn off all **cell phones, iPhones, iPods, iPads, cameras, etc.** during class. **THANKS !!!**