Syllabus for MCB 4009 / 5013: Structure and Function of Macromolecules, 3 credits, (2026)

12:30-1:45 pm Tuesday/Thursday
E2 321

Instructor

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Office Hours: Tu/Th 3:00-4:00 pm (**by e-mail appointment only**)

Part 1: Basics of protein structure		
Jan 20	**(1)**	Intro to protein structure: myoglobin & hemoglobin [**1**]
22	**(2)**	Building blocks amino acids, dihedrals B&T Chapter 1 + [**1b**]
27	(**3**)	Secondary & tertiary structure B&T Chapter 2
29	**(4)**	Forces Stabilizing protein structure
Feb 3	**(5)**	Protein folding B&T Chapter 6 (pg 89-98)+ [**2**]
5	**(6)**	Protein Evolution, structure databases [**3**]
10	**(7)**	All alpha proteins B&T Chapter 3
12	**(8)**	α/β proteins and all beta proteins B&T Chapter 4 + 5
17	**(9)**	Conformational transitions B&T Chapter 6 (pg 104-119)
Part 2: Structure determination techniques		
19	**(10)**	Molecular dynamics & IDPs **[4,4b]** B&T Chapter 9 pg 166-172 for p53
24	**(11)**	Electronic spectroscopy **[5]**
26	**(12)**	Protein NMR 1 B&T Chapter 18 + [**6**]
Mar 3	**(13)**	Protein NMR 2 B&T Chapter 18 + [**6**]
5	**(14)**	X-ray crystallography 1 B&T Chapter 18 + **[7]**
10	**(15)**	X-ray crystallography 2 B&T Chapter 18 + **[7]**
12	**(16)**	**EXAM I**
Spring recess: No Classes March 15-22		
24	**(17)**	Microscopy: TEM, CryoEM, AFM, [8**, 8b]**
26	**(18)**	Protein structure prediction B&T Chapter 17
Part 3: Advanced topics		
31	**(19)**	Membrane Proteins B&T Chapter 12
Apr 2	**(20)**	Zinc finger transcription factors, zinc-fingers B&T Chapter 10
7	(**21**)	Oligomeric proteins and viruses B&T Chapter 16
9	**(22)**	Virus structures COVID and P22 B&T Chapter 16
14	**(23)**	Fibrous proteins B&T Chapter 14
16	**(24)**	Amyloids I- Intro **[10]**
21	**(25)**	Amyloids II- IAPP **[10]**
23	**(26)**	Posttranslational modifications **[9]**
28	**(27)**	Signal Transduction B&T Chapter 13
30	**(28)**	**EXAM II**

May 1 last day of classes

Exams, Assignments and Grades:

The exams will count for 66% (Exam 1 = 33.3%, 2 = 33.3% for a total of 66.6%) of your total course grade. Homework assignments (there will be between 4 and 5 HW assignments) will count for the remainder 33.3% of your course grade. Class participation will also be considered in cases of borderline grades! **Your final grade is based on the exams and homework problems as described above. There are no "extra credit" assignments or alternative exams if you don't like your grade – so don't ask!**

Readings:

This semester we will be using a textbook – Introduction to Protein Structure by Branden & Tooze. Assigned chapters are marked "B&T Chapter X". In addition, I have assigned papers, indicated by "[**bold numbers**]". Read the textbook chapters, primarily. The assigned papers are useful references, and timely reviews that are good to know about, and that can help you understand and further explore the subject. The class lecture notes are the most important study resource for the exams!

1. Perutz, M. (1964). The hemoglobin molecule. *Sci. Amer 211*: 64-76.
1b. Eisenberg, D. (2003). The discovery of the α-helix and β-sheet, the principal structural features of proteins. *PNAS 100*: 11207-11210.
2. Anfinsen, C.B. (1973). Principles that govern the folding of protein chains. *Science 211*: 64-76.
3. Chothia C & Lesk AM (1987) The Evolution of Protein Structures. *Cold Spring Harb. Symp. Quant. Biol. 52:* 399-405.
4. Karplus, M. & McCammon, J.A. (2002). Molecular dynamics simulations of biomolecules. *Nature Struct. Biol. 9*: 646-652
4b. van der Lee, R, et al., (2014). Classification of intrinsically disordered regions of proteins. *Chemical Reviews 114*: 6589-6631.
5. Barth, A, (2023). Introduction to spectroscopy. *Stockholm University lectures*: https://www.youtube.com/playlist?list=PLm9edRZ1r8wWSE3BruFy06q3ckvjzlTfn
6. Wüthrich, K (2003). NMR studies of structure and function of biological macromolecules. *Angew. Chem. Int. Ed. 42*: 3340-3363.
7. Wlodawer, A., Minor, W., Dauter, Z. & Jaskolski, M. (2003). Protein crystallography for non-crystallographers, or how to get the best (but not more) from published macromolecular structures. *FEBS J. 275*: 1-21.
8. Fernandez-Leiro, R & Scheres, S.H.W (2016). Cryo-EM in molecular and cell biology. *Nature 537*: 339-346.
8b. Saibil, H.R. (2022). Cryo-EM in molecular and cell biology. *Molecular Cell 82*: 274-284.
9. Prabakaran, S., Lippens, G., Steen, H. & Gunawardena, J. (2012). Post-translational modification: nature's escape from genetic imprisonment and the basis for dynamic information encoding. *WIREs Syst Biol Med 4*: 565-83
10. Ke et al., (2020). Half a century of amyloids: past, present and future. *Chem Soc Rev 49*: 5437-5509.

Plagiarism will not be tolerated!!! Copying from a famous source (e.g. Nobel Prize winner) is not being deferential and respectful, it is intellectual theft! If you use other people's ideas make sure you describe the concepts IN YOUR OWN WORDS, and that you properly cite your sources! Please don't insult your professors by assuming they don't know enough to be able to spot plagiarism! If caught plagiarizing, you will fail the class and be subject to disciplinary action that could include dismissal from the university. Please see the definitions below, and if you have any further questions ask your instructor.

- "***Plagiarism is taking the work of another person and passing it as your own. This means***

copying from print or electronic sources. Plagiarized papers are typically...
1) Downloaded off an Internet site, 2) Copy & pasted from an online database, 3) Copied verbatim from a book or article and/or 4) Not cited accurately."

• Do not copy or share Homework Assignment or Exam answers with other students! I have caught students doing this in the past and they have gotten failing grades as well as being reported to the appropriate University Authorities!

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http://www.lib.uconn.edu/instruction/PlagFac.htm

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