SYLLABUS

Course Name: Analysis of Biological Macromolecules and Biomaterials
Course Number: Physics 7410/4410
Meeting time/day/place: 1:00 pm -2:15 pm CST, T, Th (LSC 001)
Instructor Name: Xiaoqin Zou

COURSE DESCRIPTION (including prerequisites)

This interdisciplinary lecture course introduces basic concepts and physical techniques currently being used to investigate bio-macromolecular structures and biomaterials. It uses an approach accessible to graduate students, undergraduate students, faculty and postdoctoral fellows from different disciplines. The course will be taught by a team of scientists from the departments of Physics, Chemistry, Biochemistry, and Biological Engineering at the University of Missouri, Columbia (MU), North Carolina State University (NCSU) and Indiana University at Bloomington (IU). A combined Problem Based Learning/Writing Intensive approach will be used.

The course consists of five modules to be taught in the order of the complexity of the biological materials: 1) lipid vesicles and bilayers; 2) proteins; 3) interactions between membrane and peptide/protein; 4) biomolecular interactions and cellular interactions; and 5) bio-inspired materials.

Prerequisite: University Physics II (Physics 2760) or equivalent.

COURSE LEARNING GOALS

Upon completion of the course, students can expect to have acquired the following abilities:

- Understanding of the basic knowledge of proteins, membranes, and biomaterials.
- Functional understanding of currently used experimental techniques such as neutron scattering, X-ray, NMR, FRET, AFM, molecular dynamics simulations, and understanding of what advantages and limitations these techniques have and what these methods can contribute to the student's field of research.
- Experience in analyzing data, interpreting results, writing scientific papers, and preparing grant proposals.

INSTRUCTOR INFORMATION

Coordinator: Xiaoqin Zou
E-mail: zoux@missouri.edu [preferred method of contact]
Office Location: 320 Physics Bldg., University of Missouri-Columbia
Phone: 573-882-6045

Instructors:

Silvia Bompadre (Physics, MU, bompadres@missouri.edu)

Peter Cornish (Biochemistry, MU, cornishp@missouri.edu)
Bogdan Dragnea (Chemistry, IU, dragnea@indiana.edu)
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Gavin King (Physics, MU, kinggm@missouri.edu)
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Haskell Taub (Physics, MU, taubh@missouri.edu)
Steve Van Doren (Biochemistry, MU, VanDorenS@missouri.edu)
Xiaoqin Zou (Physics and Biochemistry, MU, zoux@missouri.edu)

Coordinator at IU: David Baxter (Physics, IU, baxterd@indiana.edu)

TA INFORMATION

Not applicable

REQUIRED TEXTBOOKS AND MATERIALS

Lecture notes and references therein

COURSE POLICIES (attendance, absences, submitting late work)

Students are expected to attend all lectures and in-class discussions. Writing assignments should be submitted by their due dates. After that, **no late assignments will be accepted**.

To encourage interdisciplinary and diversified discussions, the students will be divided into groups of 3-4 members according to their background and locations. After the end of each 50-minute lecture, the students are required to participate actively in the 20-minute, in-class group discussions about the pre-assigned problems. The students of each group are also expected to discuss and share information on the assigned projects for the term reports, mini proposal, and final paper; however, **students should submit their own writing assignments independently**.

ASSIGNMENTS

- There will be a 20-minute **in-class group discussion** after each 50-minute lecture. Problems for discussions will be provided before each lecture by the lecture instructor. There will be no writing assignment for in-class group discussion. The involvement of the student in the group discussions will contribute 5% toward the total course grade.

- There will be **3 term reports**. Each term report is due two weeks after the end of Module 1, 2 and 3, respectively. Before each module, two (or one) topics related to the module will be offered to the student groups for selection. Each group will search the literature and analyze the data cooperatively. Then **every student will write his/her own term report** based on the group discussions. Each term report will account for 15% of the total grade.

Format of the Term Report: (1) Times New Roman at a font size of 11 points; a font size of less than 10 points may be used for mathematical formulas or equations; (2) the margins must be one inch on all sides; (3) a standard, single-column, double-space format should be used; (4) tables, figures and captions should be placed after the bibliography; (5) the length requirement of the term report is 4 pages, excluding bibliography, tables, figures, and captions.

- There will be **a two-page mini proposal**. The mini proposal is due two weeks after the end of Module 4. The proposal should be for measurements at a neutron scattering facility to answer a structural or dynamic question related to Module 4, "protein-ligand interactions, protein-protein interactions, and cellular interactions". The format should follow the requirement of beam-time proposals at NIST or Oak Ridge National Laboratory. The proposal will contribute 15% toward the total grade.

- There will be a **final paper**. In last four weeks of course, students are required to write an article following the format of a peer-reviewed journal article. The format requirement of the final paper is the same as that of the term report, except that the length requirement is 6 pages. Students will select a topic (with instructor approval), which examines an issue related to one of the five modules in greater depth. The article will be submitted and evaluated in two drafts. The second draft will serve as the final exam for the course. A "Review Board" of at least two instructors will read the first draft of the paper so that the student's writing will be evaluated from several disciplinary perspectives. The final paper will contribute 35% toward the final grade.

- Additional notes about writing assignments:

    (1) Feel free to use data and figures that you find in literature as if they were your own research results. However, cite the relevant references in your text and figure captions when you use the results.
    (2) One may not copy sentences and paragraphs from literature. Copying of other people's sentences and paragraphs is considered to be "plagiarism" and will result in a failing grade on an assignment if found.

GRADING SCALE (include +/- grades)

A: > 85% B: 70-85% C: 60-70% D: 40-60% F: < 40%

SEQUENCE OF TOPICS BY WEEK (OR LECTURE)

Hands-on Modules	Lectures
Module 1: Lipid vesicles and bilayers Term project design: Taub	Lecture 1: Neutron scattering (NS) experiments (Taub, Aug 21) Lecture 2: Molecular dynamics (MD) simulations (Kosztin, Aug 23)

Module 2: Proteins Term project design: Zou and Meilleur	Lecture 3: Introduction to proteins (Zou, Aug 28) Lecture 4-10: Biophysical techniques to study proteins: Lecture 4: X-ray and neutron crystallography – Part 1 (Meilleur, Aug 30) Lecture 5: X-ray and neutron crystallography – Part 2 (Meilleur, Sep 4) Lecture 6: Small-angle X-ray scattering (SAXS) and Small-angle neutron scattering (SANS) (Meilleur, Sep 6) Lecture 7: NMR – Part 1 (Van Doren, Sep 11) Lecture 8: NMR – Part 2 (Van Doren, Sep 13) Lecture 9: AFM (King, Sep 18) Lecture 10: FRET (Cornish, Sep 20)
Module 3: Interactions between membranes and peptides/proteins Term project design: Meilleur and Zou	Lecture 11: Interactions between membranes and peptides: studied by neutron scattering (Meilleur, Sep 25) Lecture 12: Interaction between membranes and proteins (Bompadre, Sep 27) Lecture 13: Molecular modeling of membrane proteins (Kosztin, Oct 2)
Module 4: Biomolecular interactions and cellular interactions Mini proposal design: Meilleur and Taub	Lecture 14: Application of X-ray crystallography to protein-ligand interactions and rational drug design (Zou, Oct 4) Lecture 15: Application of neutron scattering to protein-ligand and protein-protein interactions (Meilleur, Oct 9) Lecture 16: Biomechanical properties of cells and tissues: experiments (Forgacs, Oct 11) Lecture 17: Computational modeling of the dynamics of multicellular systems (Kosztin, Oct 16)
Module 5: Bio-inspired materials	Lecture 18: How to write a two-page proposal for beam time at a neutron scattering facility (Taub, Oct 18) Lecture 19: Nanopores and applications (Gu, Oct 23) Lecture 20: Amphiphilic peptides for neuronal tissue regeneration (Dragnea, Oct 25) Lecture 21: Virus-inspired materials for energy conversion, storage and therapeutic delivery (Dragnea, Oct 30) Lecture 22: Active matter: from self-assembly to self-organization (Dragnea, Nov 1)
Preparation of the final paper	Lecture 23: How to write and submit a scientific paper (Zou, Nov 6) Remaining weeks: Addressing questions on final paper writing (Zou)

ADA STATEMENT

The Office of Disability Services recommends that all course syllabi include a statement advising students with disabilities how to request reasonable academic accommodations. Such a statement not only helps to fulfill our institutional responsibility to inform them about the process, but also demonstrates our commitment to a positive and welcoming environment for students with disabilities.

Below is a sample statement that we suggest you consider using. It can be used as is, or can be adjusted to meet specific needs. For example, for *online courses*, the statement should reflect the desired mode of communication (e.g. via email) and can eliminate the reference to building evacuation. Thank you for including this or a similar statement on all syllabi.

> *Students with Disabilities:*
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> *If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let me know as soon as possible.*
>
> *If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please register with the Office of Disability Services (http://disabilityservices.missouri.edu), S5 Memorial Union, 573- 882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for students with disabilities, click on "Disability Resources" on the MU homepage.*

This sample statement is posted on the web at http://provost.missouri.edu/faculty/syllabus.html and at http://disabilityservices.missouri.edu/faculty/syllabus.php.

News / General Information:

- *We're going green:* Starting this semester, specific information regarding how to implement accommodations will be provided in electronic format on our website at http://disabilityservices.missouri.edu/faculty/additional-resources.php. There, you will find helpful guidance on a variety of accommodations, such as how to help students arrange for a note taker in your class, schedule an accommodated exam, or how you can work with a sign language interpreter or captionist.

- *Staff updates:* Disability Services' newest staff member is Angela Graves, our new Deaf Services Coordinator. Angela will provide support for our deaf and hard of hearing students and serve as a communication access resource on campus. Angela is a certified sign language interpreter, and will be available to provide interpreting services in the classroom as well as in other venues on campus. You will also see some other staff changes this fall as Jessi Keenoy leaves us as of August 10, Justin Lozano steps into her position as of August 13, and Becca Terry takes on the Exam Coordinator duties being vacated by Justin.

- *Communication is essential:* Students are encouraged to meet with you in person to discuss any accommodations that may be necessary to ensure access. We also advise them to provide you with a copy of the memo that identifies those accommodations. It is reasonable for you to expect that students will share this information timely, and that you will have an opportunity to talk with them to ensure that any barriers to their participation have been addressed.

- *Contact us:* Even though we offer information on our website about implementing accommodations, you may still have questions about how best to accommodate a particular student with a disability. If you do, we encourage you to contact us at 882-4696, or by email at disabilityservices@missouri.edu.

Accommodated Exams:

- Starting this semester, completed accommodated exams will be delivered back to you Monday through Friday at the following times: 8:00 a.m., 12:00 noon, and 3:00 p.m.

- Reminder emails for upcoming accommodated exams will be sent out *the evening prior to the date of the scheduled exam*.

- *Online Accommodated Exam Request Form:* We continue to work with our colleagues in the Application Development Network to enhance the functionality of the form. Updates will be implemented throughout the semester. Thank you for your patience as we work to improve the application for your use as well as for students. Remember, the URL for the form is https://apps.adn.missouri.edu/ExamAccommodation/.

Tips and Resources:

- Blackboard includes a number of features that improve accessibility for students with disabilities. We encourage you to become familiar with those features and make use of them as you design or revise your course. Information about those features can be found at http://blackboard.com/accessibility.

- A student's need for accommodations may be minimized through the use of *universal design for learning* (UDL). UDL is best described as providing a learning environment that is equitable, flexible, fully accessible, designed to meet the needs of diverse learners, using multiple means of engagement, expression, and representation. Examples of implementation of UDL include:

  - ✓ use of Tegrity (eliminates the need for note takers)
  - ✓ using captioned videos, films and other audio presentations (beneficial for not only those with sensory disabilities but also those with specific learning disabilities, students whose first language is not English, and others)
  - ✓ flexibility regarding attendance
  - ✓ providing texts in alternative formats
  - ✓ providing a flexible classroom environment with a variety of work surfaces and seating options
  - ✓ giving verbal descriptions of visual aids and graphics
  - ✓ paraphrasing questions and answers
  - ✓ highlighting key points throughout discussions

- Helpful resources:

  - ✓ The faculty section on our website – http://disabilityservices.missouri.edu/faculty/index.php - offers a variety of helpful information, including guides to implementing accommodations, the Faculty/Staff Guide to Helping Students, suggestions for and resources on universal classroom design (UDL), disability etiquette, and more.
  - ✓ Adaptive Computing Technology Center (http://actcenter.missouri.edu, 884-2828) - provides adaptive technology services and support for persons with disabilities
  - ✓ The Office of Accessibility and ADA Education (http://ada.missouri.edu/, 884-7278) - provides information on more general questions and concerns related to the ADA and 504
  - ✓ ET@MO (http://etatmo.missouri.edu, 882-3303) - supports the meaningful use of technology to improve teaching and learning (e.g. Tegrity)

UNIVERSITY POLICY ON ACADEMIC DISHONESTY

Academic honesty is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards academic dishonesty as an extremely serious matter, with serious consequences that range from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, or collaboration, consult the course instructor.

Academic Dishonesty includes but is not necessarily limited to the following:

A. Cheating or knowingly assisting another student in committing an act of cheating or other academic dishonesty.

B. Plagiarism which includes but is not necessarily limited to submitting examinations, themes, reports, drawings, laboratory notes, or other material as one's own work when such work has been prepared by another person or copied from another person.

C. Unauthorized possession of examinations or reserve library materials, or laboratory materials or experiments, or any other similar actions.

D. Unauthorized changing of grades or markings on an examination or in an instructor's grade book or such change of any grade report.

Academic Integrity Pledge:

Students are expected to adhere to this pledge on all graded work whether or not they are explicitly asked in advance to do so: "I strive to uphold the University values of respect, responsibility, discovery, and excellence. On my honor, I pledge that I have neither given nor received unauthorized assistance on this work."

The University has specific academic dishonesty administrative procedures. Although policy states that cases of academic dishonesty must be reported to the Office of the Provost for possible action, the instructor may assign a failing grade for the assignment or a failing grade for the course, or may adjust the grade as deemed appropriate. The instructor also may require the student to repeat the assignment or to perform additional assignments. In instances where academic integrity is in question, faculty, staff and students should refer to Article VI of the Faculty Handbook. Article VI is also available in the M-Book. Article VI provides further information regarding the process by which violations are handled and sets forth a standard of excellence in our community.

In the event of a suspected incident of misconduct, the instructor plans to use option B (M-book, page 11: http://www.missouri.edu/~mbook/mbook.pdf).