Special topics in Analytical Chemistry: Bioanalytical Chemistry

CHM 5180

Time: 9:20 – 10:10 Monday, Wednesday, & Friday

Location: HTL 219

Dr. Xiangpeng Li

Email: xl24k@fsu.edu (Please use your @fsu.edu address and include CHM 5810 in the subject line for quick response)

Phone: (850) 645-8617

Office Hours: Any time except Thursdays. Stop by my office, call, or email to check for availability.

Description: This course will combine an overview of standard bioanalytical methods with an advanced study of recent literature on related topics. The first two-thirds of the course will be devoted to such topics. Standard methods such as enzyme assays, biosensors, separations, and nucleic acid analysis will be covered alongside more modern techniques such as next-generation sequencing, digital PCR, proximity assays, microfluidics, and fluorescence microscopy. During this portion, pairs of students will be assigned to review articles, will turn in a written review, and will lead the in-class discussion on these articles. The final third of the course will be devoted to formal student presentations (via Powerpoint slides) on a bioanalytical research project design. Overall, students will become more comfortable with reading bioanalytical literature and will reach a new level of insight regarding the advantages and limitations of each technique discussed. These approaches will enhance the students' judgment in choosing methods for their own research.

Grading: The grading will be based on class participation, assignment, project presentation and exam.

Items	Percentage
Class Participation	10%
Literature Review Assignment	20%
Exam	30%
Presentation	40%

Class Participation: It is extraordinarily difficult to do well in this class without attending lectures. If you do not plan on attending lectures, please drop the course now. Students are expected to actively participate in class discussion and group activities.

Literature Review Assignment: For this assignment, individuals or pairs of students must write a review of their assigned article covering an advanced topic in bioanalytical chemistry. The student(s) will informally present this review to the class by leading discussion and turn in their written review. As stated in the syllabus, this assignment will be worth 20% of your total grade for the course. The general outline and timing of this assignment is as follows:

1) Dr. Li will select pairs of students, if enrollment numbers permit.
2) Dr. Li and the student pairs will select one article by mid-September.
3) Student pair will add their article to the list on the class Canvas entitled "CHM5810-literature-review-fall-2024". A brief, one- or two-sentence summary and a link to the article should be included. All summaries and links must be added by the end of September, and this information can be modified throughout the semester.
4) A schedule of review assignments will be given, with the review dates determined by class enrollment. Prior to each in-class review, all students must read the article of interest. For students not assigned to the review, I will ask questions randomly during the discussion to gauge your understanding, and this will count toward your Class Participation grade (i.e. part of the separate 20% of total grade).
5) Two-page, single-spaced, written reviews must be submitted Dr. Li by 8:00 am on the day they will be discussed in class. A review template and one example review will be uploaded to Canvas for guidance.
6) During the lecture on their assigned date, students or pairs will lead the in-class discussion of their article. For pairs, one student should read the article summary portion, then both students will alternately read critiques or praises of the article. Note that critiques can be minor (e.g. typos, figure mistakes) or major (e.g. misinterpreted data) in nature. A mixture of major and minor critiques is preferred.
7) Each student or pair will be assigned a grade (worth 20% of total) based on the written review and in-class discussion.

Proposal Presentation Assignment: Groups of 2-3 student will write a 2-page research proposal (single spaced, Arial, 11-point font) that uses a specific bioanalytical technique for a research project. The proposal is due by the end of October. Each group will present their proposal in front of the class. The class will discuss the proposal to decide whether to fund the project. More details and examples will be provided by Dr. Li during in-class preparations.

1) Specific aims (due by the mid-October)
   - One paragraph to discuss the overall objectives of the project and proposed bioanalytical approaches.
   - Dr. Li will provide feedback on the aims.
2) Proposal should include the following (due by early November).
   - Title: A concise and descriptive title that clearly reflects the research topic. (10 points)
   - Introduction: Background and context, research problem/question, Rational/justification. (10 points)
   - Research Objectives or Hypotheses: Objectives: Clearly state what you aim to achieve with the research. Hypotheses: If applicable, present the hypotheses you will test. (10 points)
   - Research Methodology: Describe the overall approach with emphasis on the specific bioanalytical methodology. (30 points)
   - Alternative approaches: Describe the other approaches that can be used and provide the reasons that why these methods are not the top choices. (10 points)

- Expected outcomes: Discuss the potential findings and their implications for the field. (10 points)
- Cost Estimates: Break down the costs associated with your research, including materials, instrumentation (you don't have to purchase the equipment, if you have access of the instrument in a shared facility), personnel, and any other expenses. (10 points)
- References: Provide a list of all the sources cited in the proposal. (10 points)
- In-class presentation (50 points)

3) Proposal peer review (50 points) (due in 2nd week of November)
   - The peer review rubric will be provided by Dr. Li.
   - Each student will review 2 proposals and write a peer review report on each proposal (25 points each).
4) Presentation (50 points)
   - During the presentation assigned date, students will give a 10-minute presentation about the proposed research project followed by 5-minute Q&A.
   - The peer-reviewers and the class will judge the significance of the proposed research project and decide whether the research project should be funded or not. (The funding result will not affect the grading.) More details will be provided by Dr. Li during in-class preparations.
   - Two presentations will be given during each lecture during the group project period of the course (*dates based on enrollment*).

Exam: The university exam is 7:30 a.m. – 9:30 a.m. on Monday, December 9th. The exam will cover the lecture topics and literature analyses.

Generative AI: Generative AI tools - such as ChatGPT, Perplexity, Copilot, and others - are encouraged in learning a new topic, organizing thoughts, gathering informations, grammar check. But *should NOT be used in the first draft of your literature reviews and proposals*. Be mindful that Generative AI can produce convincing but incorrect or misleading information. Always verify the outputs, particularly when the content involves facts, news, or important decisions.

Required Items:

- Computer: Each pair of students will be required to bring one or more devices for in-class activities and projects. Laptop computers, tablets, and even smartphones are functional. I strongly recommend the use of laptops, in lieu of smartphones or tablets.

Resources: All reading materials will be provided via Canvas.

Below are some recommended texts, but these are not required.

- Bioanalytical Chemistry 2nd Edition, 2016; Mikkelsen and Corton

- Bioanalytical Chemistry 2nd Edition, 2015; Manz, Pamme, and Lossifidis

University Attendance Policy: Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy: The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ". . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at http://dof.fsu.edu/honorpolicy.htm.)

Americans With Disabilities Act: Students with disabilities needing academic accommodation should: (1) register with and provide documentation to the Student Disability Resource Center; and

(2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

This syllabus and other class materials are available in alternative format upon request.

For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center 874 Traditions Way 108 Student Services Building Florida State University Tallahassee, FL 32306-4167 (850) 644-9566 (voice) (850) 644-8504 (TDD) sdrc@admin.fsu.edu http://www.disabilitycenter.fsu.edu/

Free Tutoring from FSU For tutoring and writing help in any course at Florida State University, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of tutoring options - see http://ace.fsu.edu/tutoring or contact tutor@fsu.edu for more information. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Syllabus Change Policy

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.

Lecture Topics (The order of the lecture is subject to change):

1. Quantitative instrumental measurements
2. Spectroscopic methods
3. Enzyme and Enzyme based assays
4. Antibodies and Quantitative immunoassays
5. Biomolecule recognition (Antibody, Biotin, aptamers, and other)
6. Biosensors
7. Fluorescent microscopy
8. New Bioanalytical methods development criteria (COVID-testing case study, design thinking)
9. Super-resolution sequencing (Expansion microscopy)
10. Electrophoresis
11. Chromatography of Biomolecules
12. Mass Spectrometry of Biomolecules
13. Lab on a chip, micro-TAS, and Microarray devices
14. Droplet microfluidics
15. PCR and qPCR
16. Digital PCR (droplet based, microarray, and microwells)
17. Genomic sequencing Sanger (Chemical reactions)
18. Next generation sequencing (Illumina, Ultima)
19. Nanopore sequencing (DNA seq, RNA seq, epigenetics, peptides)
20. Single cell sequencing (scRNA-seq, barcoding)
21. Spatial genomics sequencing (FISH, Merfish)
22. Validation of New Bioanalytical Methods