CHEM 423: Bioanalytical Chemistry

*This syllabus is subject to change by the instructor*

**Instructor:**
Dr. Jay G. Forsythe (he/him; “Dr. Jay” or “Dr. Forsythe”)
Assistant Professor
Department of Chemistry and Biochemistry
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Phone: 843-953-5052
Office: SSMB 112
Office Hours: Wed 9:30 AM – 11:30 AM and/or Zoom (email for appt)

**Time and Location:** Monday 1:00 – 5:00 PM; SSMB 300 first, then SSMB 321 / 336 / 338 / etc.

**Course Summary:**

Bioanalytical Chemistry is an advanced lecture and laboratory research course (1-hour lecture, 3-hour lab each week) where students gain proficiency with instrumental methods and data analysis relevant to the study of biochemistry. Students work in small teams to characterize an unknown biological molecule throughout the semester. The specific projects and techniques will change depending on the research interests of the faculty member teaching the course.

**Effects of the COVID-19 Pandemic and/or Other Interruptions:**

*The health and safety of all persons is of utmost importance. DO NOT come to class, lab, or in-person office hours if you are actively infected with COVID-19, are ill and/or experiencing COVID-like symptoms (even mild), or are required to quarantine.*

It is highly recommended to be both fully vaccinated and boosted against COVID-19 to minimize the risks involved with in-person instruction and lab work. As long as there is a campus mask mandate, you will be required to wear a mask in class and in the lab. High-quality N95 / KN95 masks are preferred over surgical or cloth masks. Your instructor can provide a few for you to use.

If in-person meetings are suspended at some point in the semester, your instructor will announce a plan for a change in modality to ensure the continuity of learning. All students must have access to a computer equipped with a web camera, microphone, and Internet access.

**Name and Pronoun Statement:**

Dr. Forsythe will gladly honor requests to be addressed by the name and/or pronouns of your choosing. Please inform him early in the term, via your CofC-issued email account or in person.

**Attendance and Participation:**

It is important to come to class if you are healthy and able as you will be learning hands-on techniques. This course relies upon group work, both in and out of the lab. It is also necessary to communicate regularly and work together with your group. In my class, I expect all persons to be fully welcomed and treated with dignity. Disrespectful behavior towards other students or Dr. Forsythe will not be tolerated.

If you miss class, the day’s materials will be posted to OAKS. Please inform the instructor before if possible. Multiple unexcused absences may negatively affect your safety and participation grade contribution.
Required Materials:

- Face mask (at the time of writing; N95 or KN95 highly preferred)
- Safety glasses or goggles
- Lab coat
- Nitrile gloves (not latex)
- Calculator
- Laboratory notebook: either a bound composition notebook or use tablet / laptop to serve as a virtual laboratory notebook (via OneNote / Microsoft Teams). Students may choose.

Safety:

Attendance to the first week’s safety presentation (or a make-up) is required prior to experimental work. Official departmental policies can be found at: http://chemistry.cofc.edu/about/policies/index.php.

As a reminder:

- You must wear your safety glasses or goggles in lab at all times.
- Long pants are required in the lab.
- Footwear must provide adequate protection to the entire foot. Sandals, open toe shoes, mesh top shoes, and shoes with extremely high or narrow heels are inappropriate for laboratory conditions and will not be permitted.
- Socks are required. If you wear leggings and ankle socks to class, you will be asked to leave until you have socks that cover your ankles. No skin should be visible below the knees.
- You are advised to tie back long hair and wear shirts that offer full coverage.
- Lab coats are required to cover your arms and protect your clothes.
- Nitrile gloves must be worn when working with solutions and other reagents.

Course Communication:

Major announcements will be discussed in class, sent via email, and posted on OAKS. All course materials will be posted to OAKS. If you would like to schedule a meeting with Dr. Forsythe, please send him an email and/or come to office hours on Wednesday morning.

Accommodations for Students with Disabilities:

Any student eligible for and needing accommodations because of a disability is requested to speak with Dr. Forsythe during the first two weeks of class, or as soon as the student has been approved for services so that accommodations can be arranged. There will not be handwritten exams in this course. Here is a link to the SNAP website: Center for Disability Services/SNAP.

Academic Integrity Statement:

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when suspected, are investigated. Each incident will be examined to determine the degree of deception involved.

Incidents where Dr. Forsythe determines the student’s actions are related more to misunderstanding and confusion will be handled by him directly. The instructor designs an intervention or assigns a grade reduction to help prevent the student from repeating the error. The response is recorded on a form and signed both by the instructor and the student. It is forwarded to the Office of the Dean of Students and placed in the student’s file. Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students.

Students can find the complete Honor Code and all related processes in the Student Handbook at: http://deanofstudents.cofc.edu/honor-system/studenthandbook/.
Student Learning Outcomes (SLOs):

1. Prepare protein samples for experimental analysis.
2. Operate bioanalytical instruments and learn how they work and are maintained.
3. Investigate protein molecular weight distribution and structure.
4. Digest protein into peptides using a standard proteomics methodology.
5. Separate peptides using ultra- or high-performance liquid chromatography and fragment them using tandem mass spectrometry.
6. Interpret tandem mass spectrometry data and assign peptide sequences by hand.
7. Identify an unknown protein using both molecular weight and peptide sequencing data.
8. Use proteomics software to sequence peptides and identify proteins in complex mixtures.

Evaluating Student Learning:

Due to the combined lecture-and-lab nature of this course, each learning outcome will be assessed in two ways: (1) by reading assigned primary literature associated with the topic and writing one-page summaries, and (2) by carrying out experiments in the lab with your team, analyzing the data, and presenting it twice throughout the semester.

Individual Writing Assignments:

Students will work independently for the literature / writing assignments. Papers will be uploaded to OAKS and graded using the below standards-based rubric. All feedback will be provided through the OAKS Turnitin app. Assignments will be due on OAKS at 9:00 AM the day of class.

Assignments will be graded “pass-fail.” At least three out of four criteria must be “Satisfactory” or higher for an assignment to pass. Two papers can be re-submitted for a grade throughout the term, and students can earn a third opportunity by submitting the Initial Course Survey on time.

<table>
<thead>
<tr>
<th></th>
<th>Major Revision Needed</th>
<th>Minor Revision</th>
<th>Satisfactory</th>
<th>Outstanding</th>
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<tbody>
<tr>
<td>Explanation of Science Content</td>
<td>(“below C-level”)</td>
<td>(“C-level”)</td>
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<td>Analysis and/or Application</td>
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<tr>
<td>Structure / Organization</td>
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<tr>
<td>Grammar / Writing Style</td>
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<tr>
<td>Overall Grade</td>
<td><em>(NOTPASSING)</em></td>
<td><em>(NOTPASSING)</em></td>
<td><em>(PASSING)</em></td>
<td><em>(PASSING)</em></td>
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</tbody>
</table>
Students will work in small teams to carry out research in the lab. Each student will need to maintain their own lab notebook. Lab notebooks can either be bound composition notebooks or on computers/tablets, via OneNote / Microsoft Teams. The instructor has set up a virtual notebook for each student in the class.

Each week students will perform experiments and upload their annotated data / spectra to OAKS for review from the instructor. Although work will be done in groups, each student should collect their own spectra, annotate it, and upload it to OAKS. Specific experiments are contingent upon available and functioning instrumentation.

Group lab work will be assessed twice throughout the semester, through presentations. **One will be before midterm and one will be at the end of the semester.** These will consist of 10-15 min (midterm) / 30-40 min (final) PowerPoint talks followed by a short question and answer session.

The final presentation rubric is provided below; more details will be provided at least two weeks beforehand. Possible overall scores are **Outstanding, Satisfactory, Marginal,** and **Unsatisfactory.** A simplified rubric will be used for the midterm presentation, likely consisting of SLOs #1-3 and the last two criteria.

**In order to achieve an overall “Outstanding” score on your final presentation, at least six out of ten criteria must be “Outstanding” with no criteria below “Satisfactory.” In order to achieve an overall “Satisfactory” score, at least six out of ten criteria must be “Satisfactory” or higher and no criteria can be “Unsatisfactory.”**

<table>
<thead>
<tr>
<th>SLO</th>
<th>Unsatisfactory</th>
<th>Marginal</th>
<th>Satisfactory</th>
<th>Outstanding</th>
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<tbody>
<tr>
<td>SLO #1: Context / Sample Preparation</td>
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<td>SLO #2: Overview of Instrumentation Used</td>
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<td>SLO #3: ESI and MALDI MW / FTIR Structure</td>
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<td>SLO #4: Digestion / MALDI Fingerprinting</td>
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<td>SLO #5: LC-ESI-MS/MS Method / Data</td>
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<td>SLO #6: MS/MS Sequence Walkthrough</td>
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<td>SLO #7: Summary of Protein ID (#3, 4, 6)</td>
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<td>SLO #8: Use of Software with Peptide Mixtures</td>
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<td>Organization and Data Visualization</td>
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<tr>
<td>Group Involvement / Q&amp;A Session</td>
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<tr>
<td>Overall Grade</td>
<td><strong>UNSATISFACTORY</strong></td>
<td><strong>MARGINAL</strong></td>
<td><strong>SATISFACTORY</strong></td>
<td><strong>OUTSTANDING</strong></td>
</tr>
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Overall Course Grade:

Your overall grade will be determined primarily by performance in writing assignments and lab work with your team. A student will receive an F if they do not satisfy the minimum requirements for a D.

To receive an A in this course, a student must:

- Regularly attend and participate actively throughout the term; and
- Upload annotated data to OAKS and turn in your lab notebook at the end of the term; and
- Pass at least 7 of 8 writing assignments; and
- A “Marginal” or higher grade for the midterm group presentation; and
- An “Outstanding” grade for the final group presentation.

To receive a B in this course, a student must:

- Regularly attend and participate actively throughout the term; and
- Upload annotated data to OAKS and turn in your lab notebook at the end of the term; and
- Pass at least 5 of 8 writing assignments; and
- A “Marginal” or higher grade for the midterm group presentation; and
- A “Satisfactory” or higher grade for the final group presentation.

To receive a C in this course, a student must:

- Regularly attend and participate actively throughout the term; and
- Upload annotated data to OAKS and turn in your lab notebook at the end of the term; and
- Pass at least 3 of 8 writing assignments; and
- Completes the midterm group presentation; and
- A “Marginal” or higher grade for the final group presentation.

To receive a D in this course, a student must:

- Attend and participate throughout the term; and
- Turn in your lab notebook at the end of the term; and
- Completes the midterm group presentation; and
- A “Marginal” or higher grade for the final group presentation.

Plus / minus modifications to letter grades may be done based on lab safety (including wearing of appropriate PPE), teamwork, and attendance.
Tentative Course Schedule:

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture / Lab Activity <em>(subject to change)</em></th>
<th>Assignment Due <em>(subject to change)</em></th>
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<tbody>
<tr>
<td>10 Jan</td>
<td>Course overview, syllabus, lab safety</td>
<td>Initial Course Survey</td>
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<tr>
<td>17 Jan</td>
<td><strong>NO CLASS – MLK Day</strong></td>
<td>N/A</td>
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<tr>
<td>24 Jan</td>
<td>Protein review, sample prep, types of instrumentation</td>
<td>N/A</td>
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<td>31 Jan</td>
<td>MALDI / ESI / FTIR rotations, data analysis</td>
<td>Writing Assignment #1</td>
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<td>7 Feb</td>
<td>MALDI / ESI / FTIR rotations, data analysis</td>
<td>Writing Assignment #2</td>
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<tr>
<td>14 Feb</td>
<td>MALDI / ESI / FTIR rotations, data analysis</td>
<td>Writing Assignment #3</td>
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<tr>
<td>21 Feb</td>
<td><strong>Midterm Group Presentations</strong></td>
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<td>28 Feb</td>
<td>Potential guest speaker(s)</td>
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<tr>
<td>7 Mar</td>
<td><strong>NO CLASS – Spring Break</strong></td>
<td>N/A</td>
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<tr>
<td>14 Mar</td>
<td>Digestion and sample prep for LC-MS/MS</td>
<td>Writing Assignment #4</td>
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<tr>
<td>21 Mar</td>
<td>LC-MS/MS</td>
<td>Writing Assignment #5</td>
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<tr>
<td>28 Mar</td>
<td>LC-MS/MS</td>
<td>Writing Assignment #6</td>
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<td>4 Apr</td>
<td>LC-MS/MS and data analysis</td>
<td>Writing Assignment #7</td>
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<tr>
<td>11 Apr</td>
<td>LC-MS/MS and data analysis</td>
<td>Writing Assignment #8</td>
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<tr>
<td>18 Apr</td>
<td>Data analysis</td>
<td>Writing Assignment Corrections (#1-8)</td>
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<tr>
<td>25 Apr</td>
<td><strong>Final Group Presentations</strong></td>
<td>Final Course Survey</td>
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