Advanced Analytical Techniques
CHEM 4344-A (2240)
Spring 2017

Instructor: Dr. Richa Chandra, Assistant Professor
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Office: Robertson B111
Phone: (713) 942-5928
Office hours: Tu 1 – 3:30 PM – 2 PM; W 11 AM – 12:30 PM, 2 – 3:30 PM; F 11 AM – 12:30 PM
If you cannot make it to scheduled office hours, please email me in advance to set up an appointment.

CLASS MEETING:
Lecture: Th 1:10-4:00 PM, Robertson B114

PREREQUISITES: Analytical Chemistry with Laboratory, CHEM 3345/3145

COURSE MATERIALS:
   (recommended)
2. Laboratory Composition Notebook (required)
3. Laboratory coat and goggles (required)
4. Mendeley Software (free download: https://www.mendeley.com/download-mendeley-desktop/)
   (required)
5. Laptop or tablet (recommended)

COURSE DESCRIPTION: Advanced Analytical Techniques is an advanced course with an applications-focused approach to analytical chemistry and an emphasis on the development of analytical skills useful to any scientific field. A major component of this course will be method development and optimization. Students will be expected to draw on prior knowledge of general and analytical chemistry concepts and laboratory skills. This course will allow the student to delve deeper into the analytical process using a variety of modern analytical techniques and instrumentation to separate, identify, and quantify analytes. Students will be encouraged to select new techniques and instrumentation that involve industrial, clinical, and environmental applications.

LEARNING OUTCOMES: Students in this course will advance their chemistry knowledge and skills through an extensive exploration of the following components of the analytical process:
- formation of hypotheses based on a thorough examination of scientific literature and the theories behind analytical instrumentation
- method development involving selection of appropriate analytical tools
- safe and competent operation of analytical instrumentation
- detailed statistical evaluation of data, results and experimental error
- optimization of experimental design
- examination of the robustness and limitations of the methods employed
- and effective dissemination of scientific findings.

ELECTRONIC RESOURCES: Assignments as well as additional online resources for this class will be posted on Blackboard. You are required to check your Blackboard account and UST email for such information and other important announcements for the class daily.
**GRADING:** The percent contribution of each type of assignment, participation, and exams to the final grade is shown below. For further descriptions of each category, see below.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Contribution to Final Grade</th>
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</thead>
<tbody>
<tr>
<td>Performance</td>
<td>5%</td>
</tr>
<tr>
<td>Class Presentations</td>
<td>30%</td>
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<tr>
<td>Proposal</td>
<td>10%</td>
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<tr>
<td>Lab Notebooks</td>
<td>5%</td>
</tr>
<tr>
<td>Final Manuscript</td>
<td>25%</td>
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<tr>
<td>Final Presentation</td>
<td>25%</td>
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</table>

Final letter grades will then be determined by calculating the percentage points earned compared to the total number of points possible, and grades will be assigned on the following scale. Final letter grades may be reported with a plus or minus.

- **A** 100–93
- **A-** 92–90
- **B+** 89–86
- **B** 85–83
- **B-** 82–80
- **C+** 79–76
- **C** 75–73
- **C-** 72–70
- **D+** 69–66
- **D** 65–60
- **F** < 60

**PERFORMANCE:** You are expected to attend and be on time for class. If you must miss class for any reason, you should notify me before the scheduled class time. In the even of any absence, email me with the subject "ABSENCE," The participation grade will include, among other things, your preparedness, clarity and depth of your questions and answers during class presentations, and peer evaluations from your group members at the end of the semester. I will keep a record of who is asking questions and participating. In addition, I will evaluate and grade you on appropriate lab attire, timeliness, safety, laboratory skills, preparation for the experiments, cleanliness and respect for your teammates. You and your team should always properly clean the common areas in the laboratory and your personal workspace.

**CLASS PRESENTATIONS:** The first presentation will be a literature review of at least 3 (preferably 4-5) peer-reviewed journal articles that provide background information regarding your analyte(s) of interest. The review will include information regarding the physical and chemical properties of your analyte(s), their function, along with information about methods used to measure and analyze the analyte(s).

The second presentation will be your proposal presentation in which you can provide a brief review from the first presentation, your hypothesis, experimental plan, and a focus on the analytical method selected. You should include information regarding the purpose, limitations and detection limits, types of samples, controls, and calibrations used in the method. You will describe your sampling process and how you will prepare samples, controls, and calibrations.

**Group meeting presentations** will be short informal PowerPoint presentations (10 minutes max) in which you will state hypothesis and give a project overview again, present initial results with statistical analysis, interpret the results and discuss potential pitfalls / experimental errors, revisit hypothesis, present additional literature (2-3 articles) for ideas on experimental revision, and at the end invite questions and discussion from class.

All presentations should be properly cited.
PROPOSAL: Write up your statement of purpose, a materials table, and an experimental plan (procedure) including all reagents and quantities necessary to perform sample preparation and analysis. The materials table MUST include: ALL chemical or special materials required for the experiment, vendor information with catalog numbers (Sigma-Aldrich, Fisher Scientific, or VWR), exact quantity (mass or volume) needed, and the price.

LAB NOTEBOOKS: I will grade you on the format of your notebook (see Blackboard handout on Laboratory Notebook Format) including the Table of Contents, page numbering, proper titling, and statement of purpose, materials, experimental procedure, data and results for completeness and correctness. Each time you begin a new part of your project, you should include a statement of purpose detailing if you are re-examining something or starting anew. Everything in your lab notebook should be written in INK! Include data and results from Excel as printouts taped or pasted as separate pages. Make sure your Table of Contents is always up to date. Please see me for examples if needed.

FINAL MANUSCRIPT: After completion of experimentation, you will submit a formal manuscript in ACS Analytical Chemistry format. Include the following information:
1. Abstract: This will include your statement of purpose, a summary of the results, and conclusions drawn from the experimentation. Look at published articles from Analytical Chemistry for examples.
2. Background: This section will provide the backdrop for the project. It will include the theories behind the experiments, the principles of the techniques used and the relevance and scope of the purpose, which should be restated here. This is the section where you show that the project was meaningful and has some tangible impact. It does not have to be limited to the immediate experiment but to the general topic of the experiment. All ideas that are not original should be properly referenced (see the ACS Style Guide).
3. Materials and Method: In this section you will provide a list of the chemical materials used and where they were purchased. You will then briefly describe the experimental procedure. If you used a published procedure, make sure you properly reference it. Any specialized instrumentation should be included in the procedure along with the manufacturer. Please see ACS publications as a guideline.
4. Data and Results: In this section you will present all relevant Data (in tabular format) and Figures. All data should be reported here prefaced by statement(s) that describe the data prior to its appearance in the report.
5. Conclusions: In this final section, you will summarize the data and results and discuss the statistical significance of the results. Based on this analysis, you will make concluding statements in light of achieving the statement of purpose. Reference your conclusions where they agree with other studies from the literature. Discuss the impact of the work and indicate future directions.
6. References: List all resources and use proper Analytical Chemistry formatting. Mendeley is a reference manager that is free to download and can be used for organizing all your citations. At least 7 references should be used.
FINAL PRESENTATION: Each team (3-4) of students must formally present all the elements of the project including background information, review of the revised hypothesis, complete results with in-depth statistical analysis, discussion and conclusion. All members should participate and will be asked individual questions by the professor and students. You will be evaluated on your presentation skills, critical scientific thinking, statistical data analysis, and your scientific conclusions. In addition, I will also evaluate you on your ability to engage in presentations given by your peers in terms of the questions you ask and your attention to the science behind others’ experiments. Half of your grade will come from assessment by the audience, and half of it will be based on my assessment.

ACADEMIC HONESTY: I expect that you do all work within this course (including written in class assignments, homework, and exams) with honesty and integrity. Academic Dishonesty includes (but not limited to) cheating on exams or quizzes and plagiarizing from sources such as textbooks, websites, or classmates work. I consider it academically dishonest to submit work plagiarized from any source including a solutions manual or exam/homework file. You may receive a zero on the assignment in question if you submit academically dishonest work.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES: University of St. Thomas will make reasonable accommodations for students with documented disabilities. If you have a documented disability that will impact your work in this class, please contact Counseling and Disability Services Office in Crooker Center. This office can be reached at (713) 525-6953 or 2169. It is the student’s responsibility to discuss any necessary accommodations with the appropriate faculty member. Testing accommodations are provided at the Career Services and Testing Center as a convenience for faculty and students. The Career Services and Testing Center is located at 3909 Graustark on the second floor of Crooker Center. The center works on an appointment basis. The student is responsible for making his/her own appointment by speaking with a Testing Center staff member.

UPDATED COURSE INFORMATION: Occasionally, I will send out an email or post an announcement on Blackboard. You are required to use your UST account to access such updated course information.

DISCLAIMER: I will adhere to the schedule and policies in this document as much as possible, but changes may be made during the semester. Announcements to this effect will be announced in lecture, by email or on your Blackboard account.

COURSE ETIQUETTE: Please be respectful of your classmates and your professor. Please do not carry on conversations with your neighbors during the lecture. If you are not respectful of the professor and your classmates, I will deduct points earned from your class participation points. To reiterate, the use of electronic devices for personal business is prohibited in class. If you have an emergency and need the use of your mobile devices for personal use, please step outside of the class to attend to it. If you are trying to inconspicuously text message or check email during class, you will be asked to leave class and will lose points from your class participation grade at my discretion.

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Tentative Course Schedule

*Note:* This is a tentative schedule for lectures and assignments and may change as the semester progresses.

<table>
<thead>
<tr>
<th>DATE</th>
<th>LECTURE TOPICS</th>
<th>Assignments</th>
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<tbody>
<tr>
<td>Jan 19</td>
<td>Introductions, Syllabus, The Analytical Method and Project Selections, Blood Born Pathogens Safety Training</td>
<td>Literature Search Read and bring 3-4 articles from the literature next week.</td>
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<tr>
<td>Jan 26</td>
<td>In Groups: Literature Search and Project Brainstorming</td>
<td>Literature Review Presentations</td>
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<tr>
<td>Feb 2</td>
<td><strong>Literature Review Presentations (in class)</strong></td>
<td>Begin work on Proposals</td>
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<tr>
<td>Feb 9</td>
<td><strong>NO CLASS – Work on Proposals and Presentations</strong></td>
<td><strong>Proposals due 02/10</strong> (Upload to Blackboard)</td>
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<tr>
<td>Feb 16</td>
<td><strong>Presentation of Proposals (in class)</strong></td>
<td>Experimental preparation</td>
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<tr>
<td>Feb 23</td>
<td>Begin Experiments – Materials will arrive</td>
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<tr>
<td>Mar 2</td>
<td>Continue Experiments</td>
<td>Statistically analyze initial results (Review Chapter 4, Harris)</td>
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<tr>
<td>Mar 9</td>
<td><strong>Group Meeting Presentations (In Class)</strong></td>
<td>Revise experimental design</td>
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<tr>
<td>Mar 16</td>
<td><strong>NO CLASS – SPRING BREAK!</strong></td>
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<tr>
<td>Mar 23</td>
<td>Continue Experiments</td>
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<tr>
<td>Mar 30</td>
<td>Continue Experiments</td>
<td>Statistically analyze new results and form initial conclusions</td>
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<tr>
<td>Apr 6</td>
<td><strong>Group Meeting Presentations (In Class)</strong></td>
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<tr>
<td>Apr 13</td>
<td><strong>NO CLASS – EASTER BREAK!</strong></td>
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<tr>
<td>Apr 20</td>
<td>Continue Experiments</td>
<td>Begin working on manuscripts and final presentations</td>
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<tr>
<td>Apr 27</td>
<td>Finish Experiments</td>
<td><strong>Turn in Lab Notebooks due 04/27</strong></td>
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<tr>
<td>May 4</td>
<td><strong>Final Presentations</strong></td>
<td><strong>Final Manuscript Due 05/05</strong> (Upload on Blackboard)</td>
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