

**CHEMISTRY 3211 – ANALYTICAL CHEMISTRY
SYLLABUS – [REDACTED]**

Catalog Description: (3-5-5) Introduction to the theory and practice of modern chemical analysis

Pre-requisites: CHEM 2211

Required Text: Skoog, Holler and Crouch: “Principles of Instrumental Analysis”
5th, 6th, or 7th edition, Thomson Brooks/Cole

Instructor:

[REDACTED]

Lab-Coordinator: Dr. David Jenson

[REDACTED]

Teaching Assistants:

[REDACTED]

Course Web Site: <https://t-square.gatech.edu/portal>

Learning Objectives:

- Provide students with the theoretical underpinnings of modern methods of chemical analysis
- Enhance student's understanding of the principles of operation and essential components of analytical instrumentation
- Enable students to gain practical experience in using laboratory instrumentation similar to that employed by practicing scientists and engineers in industry, government laboratories, or academe
- Provide students with real-world analytical challenges and the tools to solve them
- Promote a high level understanding of the applications of sampling, statistics, separation, and analysis in determining the composition of complex chemical mixtures

Assessment

"Midterm" exams will be given on [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]. The final exam will be given [REDACTED] [REDACTED] [REDACTED] and will be weighted twice the value of a "midterm" exam. The course grade will weight the student's performance in lab and lecture in the following way:

$$\text{Score} = (3 * \text{lecture} + 2 * \text{lab.}) / 5$$

A passing grade in both lab and lecture is required. Final grades will be given based on the following scale:

- A (100 – 80%)
- B (80 – 70%)
- C (69-60%)
- D (59-50%)
- F (below 50%)

Academic Integrity

Students in this class are expected to abide by the Georgia Tech Honor Code and avoid any instances of academic misconduct, including but not limited to: (a) Possessing, using, or exchanging improperly acquired written or oral information in the preparation of a lab report or exam. (b) Submission of material that is wholly or substantially identical to that created or published by another individual or individuals. (c) False claims of performance or work that has been submitted by the student.

See the published Academic Honor Code for further information.

<http://www.osi.gatech.edu/plugins/content/index.php?id=46>

Please note:

- Old exams are posted on the T-square course site for use in preparing for each midterm exam

- No calculators, cell phones, PDAs, or other personal electronic equipment is allowed during exams
- No formula sheets, texts, notes, or contact with colleagues is allowed during exams
- Collaboration on laboratory reports *with your lab partner* is permitted but submission of duplicate text is not
- **The use of any other student's previously submitted CHEM 3211 or CHEM 3281 laboratory report is prohibited in this course.** The term "use" is to be construed in the broadest way possible. You may not own, view, reference or possess anyone other student's CHEM 3211 or CHEM 3281 laboratory reports from any semester. This applies to electronic and paper copies. Using, owning, viewing, referencing or possessing other student's previously submitted laboratory reports will be considered a direct violation of academic policy and will be dealt with according to the GT Academic Honor Code.
- **You are explicitly forbidden from giving other students access to your CHEM 3211 and 3281 laboratory reports.** This includes drafts, non-final revisions, and submitted copies. This applies to both paper and electronic copies. Giving other students access to your laboratory report will be considered a direct violation of academic policy and will be dealt with according to the GT Academic Honor Code.
- Plagiarism is not allowed. Cite your sources!

Topical Outline:

- Introduction to Spectrometric Methods (Chapter 6)
- Essential Components of Optical Spectrometers (Chapter 7)
- Atomic Absorption and Emission Spectroscopy (Chapters 8 & 9)
- Laser Induced Breakdown Spectroscopy (Chapter 10)
- Molecular Spectroscopy in the UV-Vis Range (Chapters 13-15)
- Vibrational Spectroscopy (Chapters 16-18)
- Basic Statistics and Sampling Theory (Appendix A)
- Practical Electronics (Chapters 2-4)
- Signal to Noise Enhancement Techniques (Chapter 5)
- Potentiometry and Voltammetry (Chapters 22, 23, & 25 sections A, B, D, & E)
- Electrophoresis (Chapter 30 sections A-C)
- Fundamentals of Extraction
- Solid Phase Extraction Techniques
- Chromatographic Theory (Chapter 26)
- Gas Chromatographic Instruments (Chapter 27)
- Liquid Chromatographic Instruments (Chapter 28)
- Supercritical Fluid Chromatography (Chapter 29)
- Mass Spectrometry (Chapters 11 & 20)
- Thermal Methods of Analysis (Chapter 31)
- Optical, Electron, and Probe Microscopy (Chapter 21 sections F&G)

List of Experiments to be Conducted in the Laboratory

Rotation	Experiment	Suggested Readings*
	Determination of Phosphate by Flow Injection Analysis	<i>Ch. 13A, 13B, & 33B</i>
	Atomic Absorption Spectroscopy (expanded)	<i>Ch. 9</i>
	Laser Induced Breakdown Spectroscopy	
	Raman Spectroscopy of Denatured Alcohols	<i>Ch. 18A-C</i>
	Simultaneous Determination of Chloride and Bromide by Fluorescence Quenching	<i>Ch. 15A</i>
	Analysis of Tap Water by Anodic Stripping Voltammetry	<i>Ch. 25E&H</i>
	Solid Phase Extraction of Caffeine	<i>Ch. 20D&E</i>
	Gas Chromatography of a Phenolic Mixture	<i>Ch. 27A-D</i>
	Liquid Chromatography - Kinetics of Reactive Dyes	<i>Ch. 28A-D</i>
	Identification of MTBE, Octane, and BTEX in Gasoline by GC/MS	

*in addition to the handout prior to coming to lab to perform the experiment

General Information and Policies

- Lectures will be devoted to both theoretical and practical aspects of the analytical procedures encountered in the laboratory. Lecture topics, exam dates, and suggested readings are available on the T-square site for this course. Attendance is required of all students.
- Attendance at laboratory is required of all students. Students must be on time for each lab meeting since the laboratories are tightly scheduled and there is very little free time available. The lab will not be open at hours other than those scheduled. Students may not under any circumstances work in the laboratory without supervision. Instructions for each laboratory experiment are available on-line via T-square.
- Everyone in the laboratory will conform to Georgia Tech Laboratory Personal Protective Equipment and Appropriate Attire Policy (appended to syllabus on T-square site for this course). This includes wearing a lab coat and safety goggles at all times. Failure to comply will result in your being asked to leave the laboratory. Make-ups resulting from your failure to comply with this policy will not be permitted. There will be no exceptions.
- Each student is required to keep and maintain the equipment in working order. Instructions for each laboratory experiment are available on-line under T-square.
- Each student is required to maintain a laboratory notebook. The notebook must have the ability to create a carbon copy of the notes and data you obtained. This copy must be turned into the TA at the completion of each lab experiment.
- No cell phones are permitted in the laboratory
 - If there is an issue (family emergency, etc.), this can be waived with permission from your TA.
 - If you will be late leaving lab and you need to tell someone, let your TA know.
- All excused absences must be obtained in writing. E-mail is preferred. E-mail [REDACTED] This is for your benefit.
- If you are given an excused absence, your work relating to that laboratory must be completed within two weeks of the missed assignment. This two week period can be extended with the written permission of [REDACTED]
- You will have a pre-lab at the start of each lab period. The pre-lab will take five minutes.
- You are expected to be on-time. **If you arrive more than ten minutes late, you will be dismissed from the lab for the day and will receive a zero on that day's lab assignment.**
- You can be dismissed from lab for inappropriate behavior. Such behavior includes, but is not limited to:

- Failure to follow the instructions of your instructors or TAs.
 - Violations of the Student Code of Conduct, both academic and non-academic.
 - Failure to follow the safety rules
 - Reckless or wanton handling of equipment
 - Arriving to lab more than ten minutes late.
- Lab reports are due at the beginning of your next regularly-scheduled laboratory period.
 - Late reports will receive a **30 point deduction** on the final grade for that experiment. You will be granted an automatic seven day extension to complete your report. If your report is not submitted within eight days of the original due date, you will receive a grade of zero on the assignment.
 - Example: If your report is due on September 13th at 1:05 PM and you do not submit a report, your late report will be due on Sept 20th at 1:05 PM and 30 points will be deducted from your grade.

Chapter	Topic	Suggested Homework Problems
Appendix A	Evaluation of Analytical Data	a1-1, a1-2, a1-12, a1-21, a1-24
1	Introduction	1-1 through 1-10
2	Electrical Components and Circuits	2-1, 2-14, 2-15, 2-19
3	Operational Amplifiers in Chemical Instrumentation	3-10, 3-11, 3-16
4	Digital Electronics and Microcomputers	4-1, 4-2, 4-8 through 4-12
5	Signals and Noise	5-1, 5-2, 5-8
6	An Introduction to Spectrometric Methods	6-1, 6-14, 6-15, 6-19
7	Components of Optical Instruments	7-8, 7-12, 7-18
8	An Introduction to Optical Atomic Spectrometry	8-4, 8-9
9	Atomic Absorption and Atomic Fluorescence Spectrometry	9-11, 9-12, 9-14, 9-20
10	Atomic Emission Spectrometry	10-1, 10-11
13	An Introduction to Ultraviolet/Visible Molecular Absorption Spectrometry	13-8, 13-11, 13-20, 13-24
14	Applications of Ultraviolet/Visible Molecular Absorption Spectrometry	14-10, 14-18, 14-23
15	Molecular Luminescence Spectrometry	15-2, 15-9, 15-10
16	An Introduction to Infrared Spectrometry	16-2, 16-8, 16-13, 16-15
17	Applications of Infrared Spectrometry	17-4, 17-5, 17-10, 17-11
18	Raman Spectroscopy	18-3, 18-7, 18-9
20	Molecular Mass Spectrometry	20-2, 20-10, 20-13, 20-19
21	Surface Characterization by Spectroscopy and Microscopy	21-12
22	Introduction to Electroanalytical Chemistry	22-5, 22-9, 22-14
23	Potentiometry	23-14, 23-20, 23-26
25	Voltammetry	25-1, 25-3, 25-6, 25-11, 25-13
26	An Introduction to Chromatographic Separations	26-1 through 26-17
27	Gas Chromatography	27-6, 27-18, 27-19, 27-26, 27-27
28	High-Performance Liquid Chromatography	28-7, 28-12, 28-13, 28-21
29	Supercritical Fluid Chromatography and Extraction	29-2, 29-7
30	Capillary Electrophoresis and Capillary Electrochromatography	30-1, 30-6, 30-8
31	Thermal Methods	31-1, 31-2, 31-7, 31-8
33	Automated Methods of Analysis	33-2, 33-3