

Purpose and Approach:

The quantitative analyst seeks to answer the question, "How much of substance is in material? What are the tools used and how can one do the measurements?" In *Analytical Chemistry* course you will study some of the important ideas in analytical chemistry and do quantitative measurements. By the end of the course we hope that you will have an improved understanding of:

- The distinction between the goals of qualitative and of quantitative determinations.
- Statistical methods for evaluating and interpreting data.
- Sources of error in chemical and instrumental analysis.
- Interferences in chemical and instrumental analysis.
- The concept of instrument calibration.
- The basic concepts of stoichiometry.
- The importance to quantitation of equilibrium theory.
- The concept of an analytical standard.
- Instrument components and principles of their operation in the following areas:
 - Spectroscopy (UV-vis, fluorescence, atomic absorption, IR, Raman, x-ray)
 - Separations (GC, HPLC, electrophoresis, ion chromatography, affinity chromatography)
 - Mass spectrometry including the distinction and utility of different ionization methods (e.g., EI, CI, ESI, MALDI) and mass analyzers (e.g., quadrupole, TOF, ion trap)
 - Electrochemistry (ion selective electrodes, amperometry, voltammetry)
 - Hyphenated techniques (GC-MS, LC-MS)

The laboratory experiments that you will do and much of the equipment that you will use to do them are new to Rutgers. Sizeable grants from the university and from the National Science Foundation have made it possible to acquire the equipment. We will do our best to see that the experiments work smoothly. As in any new venture, however, we expect to have to improvise along the way. We will need your cooperation, patience, and, perhaps at times, your help. If actual seawater is not available, we will provide artificial seawater.

Lector: Dr. Kornienko

e-mail: akern@chem.rutgers.edu

Office hours: by appointment

Lectures: : Mondays, 8:40 AM to 10:00 AM via Zoom or Canvas Conference.

Open source Textbook: [Analytical Chemistry 2.0](#)

Laboratory and Instructors:

Sec 01, Wednesday from 2:15 PM to 6:55 PM _ Eric (eoh7@rutgers.edu)

Sec 02, Thursday from 9:15 AM to 1:55 PM _ Shilong (sy594@rutgers.edu)

Sec 03, Thursday from 2:15 PM to 6:55 PM _ Seungwoo (seungwoo.lee@rutgers.edu)

Laboratory Notebook: LabArchives Electronic Notebooks, which should be accessible via assignments in Canvas. Students should pay for EN at the Rutgers bookstore.

Course page is on Canvas:

All communication with students will be done using Canvas. If you are new to Canvas review tutorials at <https://onlinelearning.rutgers.edu/getting-started-canvas-students> and if there are still questions, please call to help desk at (877)361-1134. You should login to this website using your Rutgers net ID and password. **You are responsible for checking Canvas announcements and Rutgers email.**

Grades and Grading

Grades will be calculated based on the total number of points obtained in labs and exams.

All laboratory reports 66%, or 5.5% each.

Oral presentation 4%.

Two lecture exams 15% each.

Total 100%

You need to complete both, the laboratory and theoretical parts to pass the course.

Your final grade will be based on your overall percentage and the grading scale would be as follows:

- A 90%
- B 80-89%
- C 65-79%
- D 55-64%
- F < 55%

Lecture Schedule:

Week #	Lecture #	Date	Topic	Textbook Chapters*	Suggested Practice Exercises *
2	1	9/8/2020	Course intro. Measurements and calculations in analytical chemistry.	2 and 4	4.1- 4.9, 4.12
3	2	9/14/2020	Analytical methods	3, 5 and 7A-7F	5.1-5.4, 5.6-5.7, 7.3-7.4
4	3	9/21/2020	Equilibrium Chemistry. Gravimetric separations	6A-E, 6G-K, 8A-B	6.1, 6.8, 6.9, 6.14- 6.15, 8.2 -8.5
5	4	9/28/2020	Titration	9D, 11A-B	11.1-11.6
6	5	10/5/2020	Molecular orbitals and coordination chemistry	6F, 9C, Reading materials on Canvas	6.5, 6.6
7	6	10/12/2020	Spectroscopy	10	10.3-10.7, 10.10
8		10/19/2020	Exam I	Lectures: 1 - 4	
9	7	10/26/2020	IR and Raman spectroscopy	10C, Reading materials on Canvas	

10	8	11/2/2020	Nanoparticles	Reading materials on Canvas	
11	9	11/9/2020	Separation sciences	7G-H, 12A-E	7.8, 12.1-12.6
12	10	11/16/2020	Mass spectrometry	Reading materials on Canvas	
13	11	11/23/2020	Evaluation of Data	14A, 15A-C	15.1, 15.2
14	12	11/30/2020	Data Synthesis/Cross Comparison		
15	12/7/2020		Exam II	Lectures: 5 - 11	

***Textbook: on Canvas**

https://www.asdlib.org/onlineArticles/ecourseware/Analytical%20Chemistry%202.0/Text_Files_files/AnalChem2.0.pdf

Check Canvas for suggested additional reading materials and homework problems before each lecture period. Any general chemistry book would be helpful to review some topics.

- **Lecture notes** will be posted on the canvas site for this course usually on Sunday night prior each lecture. Any lecture handouts will be posted at the same time.
- **Attendance** in lectures is essential in order for a student to do well in this course. Attendance will be taken and points will be deducted for missed attendance. Significant amounts of additional material, including modifications to the lab procedure is provided in the lecture. Much of the exam material as well as what is required in the lab report will be provided during the lecture for the course in conjunction with the textbook. Lab instructors will assume that students have attended the lecture and will not provide information that has already been provided in the lecture.
- **Lecture Exams** will be given on the specified dates. The material for the exams will come from your lab experiments, pre-labs, homework problems, readings and lecture material. Make sure you do all the homework problems. The homework may be randomly collected in the lecture or the lab period. No notes, whether on paper or electronic, will be permitted on the exam.
- **Missed Lecture Exams: All exams must be taken at the scheduled times and places.** If you fail to take an exam at the scheduled time and place, you must notify your lecturer, Dr. Kornienko, promptly by e-mail and provide an acceptable explanation for your absence, or you will receive a score of zero (0) for that exam. No exceptions!

Laboratory part of this course:

Laboratory Schedule

Week #	Lab #	Sec 01_W	Sec 02_03_Th	Title	Report Due Date
1	1	9/2/2020	9/3/2020	<u>Expt 1.</u> On-line tools in analytical chemistry labs	9/7/2020
2	2	9/9/2020	9/10/2020	<u>Expt 2.</u> Chemical measurements and calculations	9/14/2020
3	3	9/16/2020	9/17/2020	<u>Expt 3.</u> Analytical methods	9/21/2020
4	4	9/23/2020	9/24/2020	<u>Expt 4.</u> Gravimetric analysis of Gravimetric Analysis of Chloride and Sulfide	9/28/2020
5	5	9/30/2020	10/1/2020	<u>Expt 5.</u> Alkalinity of seawater	10/5/2020
6	6	10/7/2020	10/8/2020	<u>Expt 6.</u> Complex compounds	10/12/2020
7	7	10/14/2020	10/15/2020	<u>Expt 7.</u> Spectroscopy	10/26/2020
8	8	10/21/2020	10/22/2020	<u>Expt 8.</u> Choosing chromatography paper for the presentation	
9	9	10/28/2020	10/29/2020	<u>Expt 9.</u> IR and Raman spectroscopy	11/2/2020
10	10	11/4/2020	11/5/2020	<u>Expt 10.</u> Synthesis of Fluorescent Carbon Quantum Dots	11/9/2020
11	11	11/11/2020	11/12/2020	<u>Expt 11.</u> Ion Chromatography – Anions and Cations in Seawater	11/16/2020
12	12	11/18/2020	11/19/2020	<u>Expt 12.</u> Mass Spectroscopy	11/24/2020
13	No New Experiment				
14	13	12/2/2020	12/3/2020	<u>Expt 13.</u> Oral presentation.	

Promptness: Laboratory session will begin and end promptly as scheduled; students will not be allowed to work overtime or during off-hours. If a student arrives late to the lab, the instructor may not authorize the student to perform the experiment. In any event, if a student arrives late to lab, he or she cannot stay longer after the lab is officially over. A record of late arrivals will be kept and will affect the grade.

- **All Laboratory experiments** are in LabArchives electronic notebooks on Canvas and will be graded based on three parts:
 - Pre-lab (20 points) should be submitted before the lab period each week.
 - Data Sheet (10 points) should be submitted on the day of the experiment each week.
 - Report (70 points) usually should be submitted before next week experiment.

- **Make-up:** A missed lab period may be made up only for valid medical reason and with a note from the doctor and the dean's office. The authorization will be given only when documentation for the excuse is provided (from a doctor and dean) to Dr. Kornienko. **The lab reports must be marked clearly with student's name, lab instructor's name and section number and turned in to the lab instructor of the section you are making up the lab.**
- **Chromatography oral presentation** should be completed during the last lab period and will have an impact on the final grade
- **Laboratory Reports Guidance** (*written by Corey Frank*) In Chem 251 you will be asked to write a lab report at the end of each experiment. Effective communication is essential in any science, and it is important to practice this skill as early and often as possible. Refer to a chemistry journal (such as JACS) for examples of the type of writing, figure labelling, and tables that are expected in this course. We recognize that, for many students, this course is the first course where they are expected to independently generate an entire report, and therefore a detailed guide has been provided on the course website.

Unless otherwise specified in the laboratory write up, all lab reports must include the following:

1. **Abstract:** Minimum 50 words. Maximum 100 Words. A summary of the important findings. Report the average; do not report individual findings. Include the units.
 2. **Introduction:** Minimum 75 words. Maximum 200 words. A brief description of the purposes of the measurements.
 3. **Experimental Methods:** Maximum ½ page. A catalog of the types of measurements made and the techniques used.
 4. **Results and Discussion:** The most important section of your report. Length will vary, but will usually be 1 to 4 pages. Numerical results should be presented as (properly labelled) tables or graphs.
- **A laboratory report** for each experiment should be completed according to the laboratory schedule (usually week following its completion at the beginning of the laboratory).
 - In a *Full* report, **all of the above sections are required** whether explicitly stated on the grading rubric or not. These reports are generally expected to be at least 4 pages and include graphs and tables, which need to be explained in the body of the text. A graph or table that is not described in the text of the report is basically useless and cannot be afforded full points.
 - In a *Short* report, all which is graded is **what is listed specifically in the grading rubric**. For some experiments, this includes an introduction, for others it does not. Descriptions of graphs and tables should still be included in the body of the text, but should be brief. These reports are expected to be 2-3 pages.
 - **Late lab reports will not be accepted.** With the permission of the lab instructor and course coordinator, only one lab report may be accepted 2 days late with 20% penalty

Absences: For an absence to be excused, valid documentation **MUST** be provided within a week of the absence to your lab instructor and Dr. Kornienko. Otherwise, the absence will not be excused. **NOTE: A student with 3 or more absences (valid or otherwise) will not pass the course.** Students are responsible for all the material from a missed lab and will be tested on it in exams.

Special Needs. Any student requiring extra time and/or other unusual testing accommodations must provide documentation supporting their circumstances and needs directly to Dr. Kornienko during the first week of classes, or immediately after these needs have been documented. **ALL** requests for extended time and/or other special accommodations for exams must be handled through the Office of Disability Services (<http://disabilityservices.rutgers.edu/>). The Office of Disability Services will be responsible for all necessary proctoring arrangements.

Academic Integrity. Rutgers University policies on academic integrity and procedures for disciplinary action (<http://academicintegrity.rutgers.edu/>) will be strictly followed. Amongst all other considerations noted in these policies, please note in particular that all exams and quizzes are **closed-book/closed-notes**, that electronic devices other than calculators are not allowed on your person during any exams, that it is strictly forbidden to share information with any other person or receive information from another person during an exam or quiz, and that it is strictly forbidden to impersonate or otherwise represent yourself as another student in any exam or quiz or have another person impersonate or otherwise represent themselves as you in any exam or quiz.

Weather and Other Emergencies: Check the Rutgers website (<http://campusstatus.rutgers.edu/>) to confirm if classes are cancelled due to weather or other emergencies. If classes are on schedule, then labs will be held as scheduled. If there is a delay in opening, as long as there are 2 hours remaining for the lab period, students should attend lab for the remaining time. Changes in schedule and other adjustments will be announced in the lecture. Students are still responsible for all the material from readings, homework problems and lecture even if a particular lab is cancelled due to weather emergency.

Campus status information will also be available through: RU-info Channel on RU-TV Channel 3, RU-info Call Center at 732/932-INFO (4636), or via these local media outlets (class cancellations only): WCTC (1450 AM), WRSU (88.7 FM), WRNJ (1510 AM), WKXW (101.5 FM), WCBS (880 AM), WINS (1010 AM), News 12 New Jersey (Channel 12)