

Course:	Quantitative and Environmental Analysis (CHEM 211)
Meets:	Jan. 25 – May 6, 2021
Prerequisites:	CHEM 163 and CHEM 163L or CHEM 201 and CHEM 201L and credit or concurrent enrollment in CHEM 211L (laboratory)
CHEM 211 covers: Theory and practice of elementary volumetric, chromatographic, electrochemical and spectrometric methods of analysis. Chemical equilibrium, sampling, and data evaluation. Emphasis on environmental analytical chemistry; the same methods are widely used in biological and materials sciences as well.	
Lecture:	MW: 11:00 – 11:50 a.m. in 0005 Physics
Office Hours:	M 1:00 – 2:50 p.m.; to be hosted in a WebEx room; send a message to the course e-mail in advance if you plan to attend
Questions:	Read this syllabus. For e-mail use chem211s2020@iastate.edu (8 a.m. – 8 p.m., M-F) with Subject: "CHEM 211 and <i>what the issue is</i> "
Quizzes:	Administered on Canvas

Course Websites:

- CHEM 211 website: <https://www.courses.chem.iastate.edu/courses/2016/fall/chem-211>
(This link is currently correct despite the typo '2016' in the url)
- Canvas: <https://canvas.iastate.edu>
- Top Hat: <https://app.tophat.com/> and <https://www.it.iastate.edu/services/tophat>

Course Registration: CHEM 211 and 211L are co-requisite courses; students in CHEM 211 are required to take CHEM 211L at the same time, or to have already received credit in 211L. Students who do not meet the co-requisite should drop the course or they will receive an F in the course. Students who **drop or audit** CHEM 211 are required to drop 211L and vice versa.

Last day to **add/drop without signatures & without counting against limit of drops:** Jan. 29 (Friday)
(To add or drop recitation or lab sections during the first week of class, use AccessPlus.)

Last day to **drop** without extenuating circumstances: Feb. 26 (Friday)
(After the first week of classes, to add/drop, come to the Undergrad Chemistry Office in 1608 Gilman. Open M-F 8 – 11:50 a.m. and 1 – 5 p.m.)

Deadline to **audit:** Feb. 5 at 5 p.m. (Friday)

Required Text & Supplies:

Top Hat subscription. ISBN: 9780986615115

- Four-year license: \$63.00

For more details, including how to redeem a license for a subscription code visit:
<https://www.it.iastate.edu/services/tophat>

Textbook options (at ISU bookstore). **ISBN:** 9781429275033

Digital (\$63.99)

Print option (New, used, and rental available, \$157 to \$241)

Scientific calculator. Texas Instruments, TI-30X IIS or similar.

Grades:

The final grade will be calculated as follows:

- 30% Exams (15% each for Exams 1 and 2)
- 20% Final exam
- 20% Online quizzes (Canvas)
- 15% Lecture quizzes (Top Hat)
- 15% Homework

The **tentative grading scheme** is 93.00% or better: A, 90.00% A–, 87.00% B+, 83.00% B, 80.00% B–, 77.00% C+, 73.00% C, 70.00% C–, 67.00% D+, 63.00% D, 60.00% D–, below 60.00% F.

Important: Final grades are based solely on graded work and are NOT negotiable; no make-up or extra credit points will be offered. The final grade distribution will be consistent with prior semesters.

Important Course Policy: Any student who discovers an error in a grade in **Canvas** must contact the teaching assistant and *bring the graded work to their TA within 1 week* of receiving the returned graded work to have the grade corrected.

Exams:

Enter the dates and times of these exams to your planner now. Do not plan any appointments or travel for those dates.

Exam dates:

- **February 22**
- **March 29**

Final Exam: Monday, **May 3**, 9:45 a.m.

The final exam is a 2-hour cumulative multiple-choice exam and will be machine-scored.

Students who have *three or more finals on the same calendar day* may request to reschedule a final. The instructor of the course having the smallest number of students is responsible for arranging an alternate examination time for the student unless make-up exam times are available in one of the other courses. To reschedule, the student must notify the instructor prior to the last day of class before the beginning of dead week so the instructor has time to make appropriate arrangements.

Course exam policies: The use of cell phones, media players, electronic translators, wireless communication devices, etc. is prohibited during exams. A Periodic Table, appropriate equations, and physical constants will be provided on the back sheet of each exam.

Scheduling conflict: There are no make-up exams. In the case of a scheduling conflict, students must contact the instructor to arrange accommodations *at least one week prior* to the exam. In the case of a *documented emergency* on the day of an exam, contact the instructor as soon as possible. An early exam will be offered for those athletes and students who are away from campus for *ISU games*,

matches, or club trips. Alternatively, a *coach* can proctor the exam. A written statement for such a valid reason (course schedule, travel for university events, medical emergency, etc.) is needed. A student who misses two exams will be asked to drop the course.

Lecture Quizzes:

Lecture quizzes will be administered through **Top Hat** in class and can be completed remotely. They will be *scored* starting on the *second Monday (Feb. 1)* of the semester. The scores will be reported in percent and each lecture is weighted equally. The **four lowest scores** will be **dropped** before the final score is calculated to help to account for team/club travel, illnesses, and emergencies. There will be *no make-up quizzes.*

Online Quizzes (Canvas):

Online quizzes will be administered through **Canvas** and are to be completed outside of class. They will be administered *weekly* starting on the *second Monday (Feb. 1)* of the semester. The scores will be reported in points and the number of points available on each quiz may vary. The **two lowest scores** will be **dropped** before the final score is calculated to help to account for team/club travel, illnesses, and emergencies. There will be *no make-up quizzes.*

Homework:

There will be **one homework set per chapter**. The **problems and due dates** are indicated in the *Tentative Schedule of Classes* on p. 6 of this syllabus. An **electronic copy** of the homework must be completed and uploaded to Canvas by 11:59 PM CST on the due date. Apps that convert an image of the homework to a clearly legible PDF, such as Notebloc (Android) are highly encouraged. The TA will grade each student's homework for completeness and only selected problems for correctness. Homework may be handed in up to one class period late for **50% of the points for completeness only**. **Illegible homework** will receive a zero.

Classroom Etiquette:

To help promote a good learning environment for all, please be respectful in your behavior towards your fellow students and your instructors. Please refrain from any disruptive activities in the class, which might affect other students. Your classmates are allowed and encouraged to ask you to discontinue distracting behavior. **Students disturbing class will be asked to leave the room. Turn off all electronic notifications** during lecture.

Resources:

Important announcements, this syllabus, lecture notes, as well as other useful information are posted throughout the semester in various content areas in **Canvas**.

Chemistry Help Center: Teaching assistants are available in the Martha E. Russell Chemistry Help Center and Resource Room, room 1761 Gilman. This Center is staffed by teaching assistants and is open M – R, 9 – 5, and F, 9 – 1.

Students with Disabilities:

Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. All students requesting accommodations

are required to meet with staff in Student Disability Resources (SDR) to establish eligibility. A Student Academic Accommodation Request (SAAR) form will be provided to eligible students. The provision of reasonable accommodations in this course will be arranged after timely delivery of the SAAR form to the instructor. Students are encouraged to deliver completed SAAR forms as early in the semester as possible. SDR, a unit in the Dean of Students Office, is located in room 1076, Student Services Building or online at www.dso.iastate.edu/dr/. Contact SDR by e-mail at disabilityresources@iastate.edu or by phone at 515-294-7220 for additional information.

Academic misconduct:

Academic Misconduct in any form is in violation of Iowa State University *Student Disciplinary Regulations* and will not be tolerated. This includes, but is not limited to: **copying or sharing answers on tests or assignments, plagiarism, and having someone else do your academic work**. Depending on the act, a student could receive an **F grade** on the test/assignment, F grade for the course, and could be **suspended** or **expelled** from the University. See the Conduct Code at www.dso.iastate.edu/ja for more details and a full explanation of the Academic Misconduct policies.

Problems and Questions:

Please check the **Frequently Asked Questions (FAQ)** in **Canvas** to see if your question or issue can be answered there. If not, email your question to chem211s20@iastate.edu. This list will be checked at least twice a day Mondays through Fridays between 8 am and 8 pm. Please write in the subject area "CHEM 177 and *what the issue is*". Be polite and business-like in your writing.

Learning Outcomes and Objectives:

Upon successful completion of this course, students will have mastered fundamental concepts in quantitative analysis (analytical chemistry).

Students will be able to:

Chapter 1 – Perform calculations and report results with correct units and convert between different types of units as required; Describe the procedure for preparing a solution and calculate quantities required to achieve the desired concentration of reagents

Chapter 2 – Select the correct laboratory equipment to complete a task and describe best practices

Chapter 3 – Represent accuracy and precision in raw data and derived quantities through the correct usage of significant figures and statements of uncertainty

Chapter 4 – Describe the characteristics of data sets that relate to their significance and spread (variance) and learn to correctly identify an outlier

Chapter 6 – Calculate the concentration of an unknown sample using titration – the addition of exact volumes of a reagent of known concentration until the two react fully

Chapter 8 – Describe the relationship between the concentrations of protons, hydroxide, and pH and the difference between strong and weak acids and bases; Calculate the concentration of each species present in solution for a weak acid or base

Chapter 9 – Use the Henderson-Hasselbach equation to calculate the pH of a solution given the concentration of a weak acid (base) and its conjugate base (acid); Describe how a buffer works, how it is prepared, and how an indicator aids in measuring pH

Chapter 10 – Describe how acid-base titrations work and calculate the concentrations of both strong and weak acids or bases based on titration data

Chapter 11 – Calculate pH and conduct titration analysis in polyprotic solutions

Chapter 14 – Describe reactions involving electron transfer to a conductor (e.g., a metal electrode) and calculate concentrations of each oxidation state of an analyte using an equilibrium statement

Chapter 15 – Describe how electrochemical potential can be utilized to measure ion concentration at liquid-liquid junctions and at membranes; Calculate ion concentration given a junction potential

Chapter 16 – Describe how redox titrations work and calculate the concentrations of redox active species based on titration data

Chapter 17 – Describe how electrochemical instrumentation can be used to measure current or charge as a function of time or electrical potential; Understand the significance of these measurements in clinical and environmental sensing

Chapter 18 – Describe the properties of light and describe how it interacts with matter; Using Beer's Law, calculate the concentration of a solute based on the light it absorbs

Chapter 19 – Describe how the intensity of light emitted from a sample is collected and how fluorescence or luminescence can be utilized for quantitative analysis

Chapter 20 – Determine the atomic composition of a sample utilizing atomic spectroscopy; Describe the working principles of instrumentation used for atomic spectroscopy including atomic emission and ion coupled plasma coupled to mass spectrometry

Chapter 21 – Describe the working principles of both chromatography and mass spectrometry; Interpret chromatograms, describing their quality, and extract information from a mass spectrum

Chapter 22 – Describe the working principles of gas and liquid chromatography, the advantages of utilizing high pressure for liquid chromatography, and how to prepare a sample for chromatography

Tentative Schedule of Classes:

	Date	Notes	Homework & Quiz dates	Chapter	Homework problems for each chapter (See due dates in column 4)
M	Jan 25*	1		Syllabus and Ch. 1 – Measurement	2, 4, 8, 10, 12, 14, 16, 18, 20, 28, 30
W	Jan 27	2	HW1	Ch. 1 (<i>Continued</i>)	
M	Feb 1	3	Quiz 1	Ch. 2 – Tools	3, 4, 5, 6, 8, 10
W	Feb 3	4	HW2	Ch. 3 – Math	2, 6, 10, 12, 16, 20, 22
M	Feb 8*	5	Quiz 2	Ch. 3 (<i>Continued</i>)	
W	Feb 10	6	HW3	Ch. 4 – Stats	4, 8, 12, 14, 16, 18, 20
M	Feb 15	7	Quiz 3	Ch. 4 (<i>Continued</i>), Ch. 5-2	
W	Feb 17	8	HW4	Ch. 6 – Titrations	2, 6, 8, 10, 14, 16, 18, 20, 22
M	Feb 22	9	Exam 1		
W	Feb 24	10	HW6	Ch. 6 (<i>Continued</i>)	
M	Mar 1	11	Quiz 4	Ch. 8 – Acids and Bases	4, 8, 10, 12, 16, 18, 20, 22, 28, 30, 32
W	Mar 3	12	HW8	Ch. 8 (<i>Continued</i>)	
M	Mar 8	13	Quiz 5	Ch. 9 – Buffers	2, 4, 8, 10, 12, 14, 16, 20, 22, 24
W	Mar 10*	14	HW9	Ch. 9 (<i>Continued</i>)	
M	Mar 15	15	Quiz 6	Ch. 10 – Acid-Base Titrations	6, 8, 12, 14, 18, 22, 26, 28, 30
W	Mar 17	16	HW10	Ch. 10 (<i>Continued</i>)	
M	Mar 22	17	Quiz 7	Ch. 11 – Polyprotic Acids and Bases	4, 8, 10, 12, 16, 18, 24, 28
W	Mar 24	18	HW11	Ch. 11 (<i>Continued</i>)	
M	Mar 29	19	Exam 2		
W	Mar 31	20		Ch. 14 – Electrode Potentials	2, 4, 6, 12, 14, 18, 20
M	Apr 5	21	Quiz 8	Ch. 15 – Measurements, Ch. 16 - Redox	Ch. 15: 2, 4, 8, 14, 26, 28
W	Apr 7	22	HW 14/15	Ch. 17 – Instrumental Methods Echem.	6, 12, 22, 24
M	Apr 12	23	Quiz 9	Ch. 18 – Light-Based Methods	2, 4, 14, 16, 18, 24
W	Apr 14	24	HW 17/18	Ch. 19 – Spectrophotometry	2, 4, 6, 8, 10, 16
M	Apr 19	25	Quiz 10	Ch. 20 – Atomic Spectroscopy	2, 6, 8, 10, 16
W	Apr 21	26	HW 19/20	Ch. 21 – Mass Spectrometry	6, 8, 10, 12, 14, 22, 24, 26
M	Apr 26	27	Quiz 11	Ch. 22 – Chromatography	4, 6, 8, 10, 16, 24, 26
W	Apr 28	28	HW 21/22	<i>Review for final</i>	
M	May 3	Final Exam, 9:45 a.m., location TBA			

*Prof. Anand scheduled to travel (or giving a virtual seminar). Kira (Head TA) scheduled to teach.

**The ISU Final examinations policy will be followed: (<http://www.registrar.iastate.edu/students/exams>).