



## SYLLABUS

### Analytical Chemistry – CHEM 3310

The University of Toledo  
Department of Chemistry and Biochemistry  
41997 - CHEM 3310 – 001  
Hon - 41998 - CHEM 3310 – 091

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<b>Instructor:</b>	Emanuela Gionfriddo	<b>Offered:</b>	FALL 2021
<b>Email:</b>	emanuela.gionfriddo@utoledo.edu	<b>Course Website:</b>	<a href="#">Blackboard Learn</a> (if applicable)
<b>Office Hours:</b>	Tuesday and Thursday (12:00-1:30pm)	<b>Class Location:</b>	Snyder Memorial 2100
<b>Office Location:</b>	BO 2007 E	<b>Class Day/Time:</b>	TR 10:00-10:55 am
<b>Instructor Phone:</b>	419 530 1508	<b>Credit Hours:</b>	2

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#### CATALOG/COURSE DESCRIPTION

Theory and applications of chemical equilibria to gravimetric, volumetric and separation techniques. Emphasis on the quantitative aspects of analytical chemistry. Two 55 minutes lectures per week.

#### COURSE OVERVIEW/ TEACHING METHODOLOGY

This course aims to provide students with a broad understanding of the principles and applications of analytical chemistry. Students are first provided with an introduction into sample collection and preparation, analytical measurements and statistical treatment of data that can be obtained from a variety of analytical methods. This course will cover important titrimetric methods: acid-base, complexometric and redox titrations. The basics of instrumental methods for chemical analysis will also be discussed, such as spectrophotometry, atomic absorption spectroscopy, mass spectrometry and some electroanalytical methods. Finally, students will also be introduced to basic separation techniques, including chromatography.

***Lectures will be delivered face-to-face.*** Lectures are designed to clarify the concepts covered and provide examples of what is expected of you in this course. Lecture notes will be posted on blackboard and used in class to help with note-taking.

The Textbook is also an important part of this course. The chapters to be read are listed on the attached daily schedule. It is recommended that you read the text before the lecture.

#### STUDENT LEARNING OUTCOMES

The students will learn about analytical chemistry topics shown in the “Course Schedule” section of the syllabus. Successful learning of these topics will help students in future chemistry-related courses and in their careers. By the end of the course, the students are expected to understand the analytical chemistry concepts and techniques needed for their involvement in chemical research.

#### PREREQUISITES AND COREQUISITES

Prerequisite: **CHEM 1240 General Chemistry II** with a minimum grade of C-.

It is critical that the students independently review all the topics that constitute pre-requisite for CHEM 3310 including:



- Chemical Equilibrium
- Acids and Bases
- Acid-Base Equilibria and Solubility Equilibria
- Entropy, Free Energy, and Equilibrium
- Electrochemistry

Other important topics that the students should be familiar with, from General Chemistry I - CHEM 1230 (pre-requisite of CHEM 1240), are:

- Matter and Measurements
- Atoms
- Molecules and Ions
- Stoichiometry Ratios of Combinations
- Reactions in Aqueous Solution

### TEXTS AND ANCILLARY MATERIALS

- ✓ *Quantitative Chemical Analysis* by Daniel C. Harris, 10<sup>th</sup> edition, Publisher: Freeman, W. H. & Company.
- ✓ Achieve Learning online homework. The access to this homework should be purchased online or in the bookstore. The instructions on how to enroll can be found below and on Black Board.
- ✓ IClicker app, free with the purchase of Achieve Learning online homework. Achieve Learning online homework
- ✓ Non-programmable, non-graphical scientific calculator (make sure you practice how to use it and perform basic functions including square and cubic roots)

### TECHNOLOGY REQUIREMENTS

Please view the [technology considerations](#) for this course, including technical skills needed, general technology requirements, and technology privacy policies.

**FOR LECTURES:** a mobile device (cell phone or laptop) and internet access are needed to engage in the interactive activities and to record attendance during the face-to-face lectures.

**FOR EXAMS:** The exams will be carried out in person and must be taken **be taken during the assigned class periods. A calculator is required to complete the exams' problems.**

**GENERAL REQUIREMENTS:** Students need to have access to a properly functioning computer throughout the semester. The Browser Check Page <http://www.utoledo.edu/dl/helpdesk/browser-check.html> will enable you to perform a systems check on your browser, and to ensure that your browser settings are compatible with Blackboard, the learning management system that hosts this course.

Software Student computers need to be capable of running the latest versions of plug-ins, recent software and have the necessary tools to be kept free of viruses and spyware.

Learner Technical Support can be found here <http://www.utoledo.edu/dl/students/learnersupport.html>



**ACCESSIBILITY OF COURSE TECHNOLOGIES:** Please view [Accessibility of Course Technologies](#) for information regarding the accessibility of Blackboard and other technologies used in this course.

### ACADEMIC POLICIES

Undergraduate Policies: <http://www.utoledo.edu/policies/academic/undergraduate/>

### COURSE EXPECTATIONS

1. Read and understand the syllabus before the course starts
2. You are responsible for understanding all the concepts that constitute pre-requisites for this course.
3. Read the textbook before the lecture, the schedule is listed below.
4. Attendance is required and attendance points will be assigned.
5. You are responsible for reading and understating the instructions for IClicker and Achieve, two software's that will be used to enhance your learning experience in this class. More info about these software are in this syllabus and will be posted on BlackBoard.
6. You are expected to be familiar with the use of a non-programmable, non-graphical scientific calculator and be able to perform basic mathematical functions.

### OVERVIEW OF COURSE GRADE ASSIGNMENT\*

You will have graded online homework on the Achieve Learning Web-based system for each chapter. To register, see the instruction provide below and on Blackboard. Each online assignment will have a specified deadline (TBA), and limited attempts (usually 3) to complete the assignment prior to the due time will be allowed.

Achieve homework access should be purchased. Achieve Learning offers a grace period on payment; for most courses, this is 14 days from the first day of the term. During sign up or throughout the term, if you have any technical problems or grading issues, please send an email to [support@saplinglearning.com](mailto:support@saplinglearning.com) explaining the issue.

#### Midterm Grading:

Will be calculated based on Exam# 1, assignments and participation points up to

#### Final Grading:

Achieve Homework + additional assignment(s) (including iClicker)	230 pts.
Participation points (iClicker)	20 pts.
Exams 1 and 2	200 pts. (100 points each)
Exam 3 ( <b>comprehensive</b> )	100 pts.
Total:	550 pts. (100%)



**Grade Scale:** These are the minimum percentages of total points needed to receive the indicated grade.

	<b>A ≥ 90%</b>	<b>A - ≥ 86%</b>
<b>B+ ≥ 82%</b>	<b>B ≥ 78%</b>	<b>B - ≥ 74%</b>
<b>C + ≥ 70%</b>	<b>C ≥ 66%</b>	<b>C - ≥ 62%</b>
<b>D + ≥ 58%</b>	<b>D ≥ 54%</b>	<b>D - ≥ 50</b>
<b>F &lt; 50</b>		

## UNIVERSITY POLICIES

### Institutional Classroom Attendance Policy

Please be aware that the university has implemented an attendance policy, which requires faculty to verify student participation in every class a student is registered at the start of each new semester/course. For this course, if you have not attended/participated in class (completed any course activities or assignments) within the first 14 days, I am required by federal law to report you as not attended. Unfortunately, not attending/participating in class impacts your eligibility to receive financial aid, so it is VERY important that you attend class and complete course work in these first two weeks. Please contact me as soon as possible to discuss options and/or possible accommodations if you have any difficulty completing assignments within the first two weeks.

### Policy Statement on Non-Discrimination on the Basis of Disability (ADA)

The University is an equal opportunity educational institution. Please read [The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance](#). Students can find this policy along with other university policies listed by audience on the [University Policy webpage](#) (<http://www.utoledo.edu/policies/audience.html/#students>).

### Academic Accommodations

The University of Toledo embraces the inclusion of students with disabilities. We are committed to ensuring equal opportunity and seamless access for full participation in all courses. For students who have an Accommodations Memo from the Office of Accessibility and Disability Resources, I invite you to correspond with me as soon as possible so that we can communicate confidentially about implementing accommodations in this course.

For students who have not established accommodations with the Office of Accessibility and Disability Resources and are experiencing disability access barriers or are interested in a referral to health care resources for a potential disability, please connect with the office by calling 419.530.4981 or sending an email to [StudentDisability@utoledo.edu](mailto:StudentDisability@utoledo.edu).

## ACADEMIC AND SUPPORT SERVICES

Please follow this link to view a comprehensive list of [Student Academic and Support Services](#) (<http://www.utoledo.edu/studentaffairs/departments.html>) available to you as a student



## SAFETY AND HEALTH SERVICES FOR UT STUDENTS

Please use the following link to view a comprehensive list [Campus Health and Safety Services](#) available to you as a student.

### SPECIAL COURSE EXPECTATIONS DURING COVID-19

Maintaining a safe campus during the ongoing COVID-19 pandemic remains a top priority. UToledo continues to follow the guidance of the U.S. Centers for Disease Control and Prevention and Ohio Department of Health to keep our campus safe.

#### ATTENDANCE

The University of Toledo has a missed class policy. It is important that students and instructors discuss attendance requirements for the course. Before coming to campus each day, students should take their temperature and complete a self-assessment for symptoms of COVID-19, such as cough, chills, fatigue or shortness of breath. Anyone with a temperature at or above 100.0 degrees Fahrenheit or who is experiencing symptoms consistent with COVID-19 should not come to campus and should contact their primary care physician or the Main Campus Health Center at 419.530.3451 or Health Science Campus Student Health and Wellness Center at 419.383.5000. For more information on the symptoms of COVID-19, please go to <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>

COVID-19 testing for sick students is available on both Main Campus and Health Science Campus. Call 419.383.4545 for an appointment. Absences due to COVID-19 quarantine or isolation requirements **are** considered excused absences. Students should notify their instructors and follow the protocols summarized in this document on [Navigating COVID-Related Course Concerns](#).

In the event that you have tested positive for COVID-19 or have been diagnosed as a probable case, please review the [CDC guidance](#) on self-isolation and symptom monitoring, and report the disclosure to the Division of Student Affairs by emailing [StudentAffairs@utoledo.edu](mailto:StudentAffairs@utoledo.edu) or by connecting with their on-call representative at 419.343.9946. Disclosure is voluntary and will only be shared on a need to know basis with staff such as in the Office of Student Advocacy and Support, The Office of Residence Life, and/or the Office of Accessibility and Disability Resources to coordinate supportive measures and meet contact tracing requirements.

#### FACE COVERINGS

Face coverings are required while on campus, except while eating, alone in an enclosed space, or outdoors practicing social distancing. Students will not be permitted in class without a face covering. If you have a medical reason preventing you from wearing a face covering due to a health condition deemed high-risk by the CDC, submit an [online application](#) to request an accommodation through the Office of Accessibility and Disability Resources. Students will need to provide documentation that verifies their health condition or disability and supports the need for accommodations. Students already



affiliated with the Office of Accessibility and Disability Resources who would like to request additional accommodations due to the impact of COVID-19, should contact their accessibility specialist to discuss their specific needs. You may connect with the office by calling 419.530.4981 or sending an email to [StudentDisability@utoledo.edu](mailto:StudentDisability@utoledo.edu).

### **VACCINATION**

Doctors and other health care professionals agree that the best way to protect ourselves and each other is to get vaccinated. Case data clearly show that vaccines remain highly effective at preventing serious illness from COVID, including the highly contagious delta variant. If you have not yet received your COVID vaccine, the University encourages you do so as soon as possible. No appointment is needed to get the shot at the UTM Outpatient Pharmacy, University Health Clinic or Main Campus Pharmacy. Once you receive the COVID vaccination, please register on the COVID Vaccine Registry site at:

<https://utvaccinereg.utoledo.edu/>.

### **SPECIAL NOTES**

It's important to note, that based on the unpredictability of the COVID-19 virus, things can change at any time. So please be patient and understanding as we move through the semester. Please refer to <https://www.utoledo.edu/coronavirus/> on a regular basis for updates to current requirements or mandates. I also ask that you keep me informed of concerns you may have about class, completing course work/assignments timely and/or health concerns related to COVID.

### **INCLUSIVE CLASSROOM STATEMENT**

In this class, we will work together to develop a learning community that is inclusive and respectful. Our diversity may be reflected by differences in race, culture, age, religion, sexual orientation, gender identity/expression, socioeconomic background, and a myriad of other social identities and life experiences. We will encourage and appreciate expressions of different ideas, opinions, and beliefs so that conversations and interactions that could potentially be divisive turn, instead, into opportunities for intellectual and personal development.



**COURSE SCHEDULE (TENTATIVE, SUBJECT TO CHANGE IN TIMING OF CHAPTERS)**

WEEK	DATES	TOPIC	Notes
1/2	8/31-9/2- 9/7-9/9	Syllabus Overview Analytical Process (0) Chemical Measurements (1)	
3	9/14-9/16	Experimental error, Statistics (3, 4) Statistical analysis (4)	
4/5	9/21-9/22-9/28-9/30	Calibration methods (5) Chemical Equilibrium (6)	
6	10/5	<b>EXAM #1</b>	<b>Exam #1 will be held on 10/5, 55 min, during class time</b>
6/7/8	10/7-10/12-10/19 (10/14- Fall Break)	Titrations & Titration Calculations (7) Activity, Equilibria (8), Monoprotic acid-base equilibria, Buffers (9) Polyprotic acid-base equilibria (10)	
8/9/10	10/21-10/26-10/28-11/2	Acid-base titrations (11) EDTA titration (12)	
10	11/4	<b>EXAM #2</b>	<b>Exam #2 will be held on 11/4, 55 min, during class time</b>
11/12	11/9-11/16-11/18 (11/11) Veterans Day	Fundamentals of electrochemistry (14) Potentiometry (15) Redox Titrations (16)	
13/14	11/23-11/30-12/2 (11/25 Thanksgiving)	Fundamentals of Spectrophotometry (18)	
15	12/7-12/9	Introduction to analytical separations (23)	
	12/14	<b>EXAM #3 → Comprehensive exam</b>	<b>Exam #3 will be held on 12/14 from 10:15 a.m.- 12:15 p.m., location TBD</b>

TOPIC	Learning outcomes
Analytical Process (0) Chemical Measurements (1)	<ul style="list-style-type: none"> <li>• the fundamentals of analytical chemistry and steps of a typical analytical workflow.</li> <li>• the role of analytical chemistry in science</li> <li>• review units conversion</li> <li>• compare qualitative and quantitative analytical methods</li> <li>• review chemical concentrations</li> </ul>
Experimental error, Statistics (3, 4) Statistical analysis (4)	<ul style="list-style-type: none"> <li>• evaluate analytical data in terms of statistics.</li> <li>• estimate types of errors in chemical analysis.</li> <li>• evaluate the effects of systematic errors on analytical results.</li> <li>• compare the experimental mean with a true value and two experimental means.</li> <li>• interpret the statistical tests.</li> <li>• interpret the sources of random errors and the effects of random errors on analytical results</li> <li>• explain the sources of random errors</li> <li>• understand the standard deviation of calculated results.</li> <li>• understand the significant figures and rounding of data</li> <li>• identify quality of experimental measurements</li> <li>• explain the confidence level and confidence limit</li> <li>• interprets statistical tests.</li> </ul>
Calibration methods (5) Chemical Equilibrium (6)	<ul style="list-style-type: none"> <li>• understanding principles of calibration in analytical chemistry</li> <li>• identify limits of detection and quantitation of an analytical method</li> <li>• interpret aqueous solution chemistry.</li> <li>• review terms such as electrolyte, acid, base, conjugate acid/base</li> <li>• explain chemical equilibrium and equilibrium constant types.</li> <li>• review solubility product, complex formation, acid and bases and pH</li> </ul>
Titrations & Titration Calculations (7) Activity, Equilibria (8), Monoprotic acid-base equilibria, Buffers (9) Polyprotic acid-base equilibria (10)	<ul style="list-style-type: none"> <li>• understanding titration calculations</li> <li>• interpret a titration curve and endpoint detection</li> <li>• learn titrations of mixtures</li> <li>• learn concepts of ionic strength, activity coefficients and systematic treatment of equilibria</li> <li>• learn acid and bases strength</li> <li>• differentiate between monoprotic and polyprotic acids and bases</li> </ul>
Acid-base titrations (11) EDTA titration (12)	<ul style="list-style-type: none"> <li>• learn acid-base titration calculation with mono and polyprotic species</li> <li>• learn about indicators</li> <li>• understand metal-chelate Complexes and EDTA</li> <li>• learn how to interpret EDTA titration curves</li> </ul>
Fundamentals of electrochemistry (14)	<ul style="list-style-type: none"> <li>• learn fundamentals of electrochemistry: galvanic cells, standard potentials and Nernst equation</li> </ul>





TOPIC	Learning outcomes
Potentiometry (15) Redox Titrations (16)	<ul style="list-style-type: none"><li>• understanding electrodes</li><li>• learn titrations based on redox reactions</li></ul>
Fundamentals of Spectrophotometry (18)	<ul style="list-style-type: none"><li>• understanding properties of light</li><li>• learn about the Beer's Law in chemical analysis</li><li>• understanding absorbance and its application in analytical chemistry</li></ul>
Introduction to analytical separations (23)	<ul style="list-style-type: none"><li>• understanding the fundamentals of chemical separations</li><li>• application of separation methods in extraction and chromatography</li></ul>

### **SPECIAL INSTRUCTION for INTERACTIVE LEARNING TOOLS: iClicker and Achieve Learning**

#### **INSTRUCTIONS TO SETUP YOUR ACHIEVE LEARNING**

- 1. Get an access code:** An Achieve access code is a series of eight uppercase letters and numbers that allows you to register for your online course. Purchase from your school bookstore - You may have purchased an access code from your bookstore, either in the form of an access card or contained in a new book.
- 2. Register for an Achieve course:** use the URL <https://achieve.macmillanlearning.com/courses/95735x>. If you go to this URL and you are not already logged in to Achieve, you will be prompted to sign in or create an account.
- 3. After logging in,** you will be prompted to enter your access code, start a grace period (free trial), or purchase access. Not all courses have a grace period so you may not see all of the options listed. Once you have entered your access code and clicked Enter, you will have access to the course.
- 4.** More info about the registration process can be found at the link:
- 5.** Once you enter your Achieve Learning page for CHEM 3310, make sure you familiarize with the content following the links below
  - 1) Assignments**
    - a) [Introduction to Assessments for students](#)
    - b) [Introduction to LearningCurve Adaptive Quizzing for students](#)
    - c) [Introduction to Diagnostics for students](#)
  - 2) E-book**
    - a) [Access your E-book tab](#)
    - b) [Download an e-book to read offline](#)
  - 3) Grades**
    - a) [View your grades](#)



## iClicker

I will be using iClicker to make our class time more engaging. This will help me understand what you know, give everyone a chance to participate, and increase how much you learn in class. This will also provide you with feedback on how well you are comprehending course concepts, help you master challenging concepts, and allow you to review material after class.

**Participating in my iClicker sessions will be counted towards your final grade.**

**You are required to participate with the iClicker student app on a smartphone, tablet or laptop.** It is your responsibility to follow the steps below to properly register your iClicker account in a timely fashion. It is also your responsibility to regularly check your iClicker records for any discrepancies and bring them to my attention within 48 hours.

In order to participate in my iClicker activities and ensure that your grades are properly reflected in the gradebook, follow the steps below:

**1. Log in to Achieve and click the iClicker link in the yellow banner at the top of the course page. If you do not already have an iClicker student account, [create one](#).**

- If you already have an iClicker account, sign in. **DO NOT create a new account.** You can only receive credit from one account.
- **iClicker access is included with Achieve**, so there is no extra cost to participate in class with the iClicker student mobile or web app! You do **not** have to buy an extra access code or subscription.

**2. Add my iClicker course to your iClicker account.**

- In your iClicker account, use the + sign to search for my course.
- In the “Find Your Institution” field, enter **University of Toledo**
- In the “Find Your Course” field, enter **Analytical Chemistry**
- Double-check the details you see to make sure you select this course:
  - **Course name** → **Analytical Chemistry**
  - **Instructor name** → **Emanuela Gionfriddo**
  - **Course code, course term** → **CHEM 3310, Fall 2021**
- Select “Add This Course” and it will be added to the main Courses screen of your iClicker account.

**3. Set up the device(s) you’ll use to participate in class.**

- You can download the iClicker student mobile app via the App Store or Google Play, or you can use the iClicker web app by signing in as a student at [iclicker.com](http://iclicker.com).



- Connect to our classroom's wifi

#### **4. Now the fun part! Participate in my iClicker class activities.**

- When it's time for class, make sure you have selected my course from the main screen of your iClicker account.
  - When I start a class session in iClicker, select the **Join** button that appears on your screen, then answer each question I ask in iClicker.
  - For short answer, numeric, and target questions, make sure you select Send.

#### **5. Keep track of your attendance, review your work, and study after class in iClicker.**

- You can review your attendance record in iClicker, making it easy for you to manage your course attendance.
- You can review your grades, performance, and participation in iClicker.
- You can bookmark the questions I asked during class to turn them into flashcards or practice tests in the [Study Tools section of iClicker](#).

#### **Academic Integrity Information**

iClicker activities fall under the provisions of our **campus academic honesty policy**. Students must not engage in academic dishonesty while participating in iClicker activities. This includes but is not limited to:

- Checking in while not physically in class
- Having another student check you into class
- Having another student participate for you
- Answering polling questions while not physically in class
- Looking at other students' devices while answering live questions
- Using more than one iClicker account at a time

Any student found to be in violation of these rules will lose their iClicker points for the entire term and may be reported to the Dean of Student Discipline.

#### **Need help with iClicker?**

- If you are having issues connecting to the iClicker student app, check out these [iClicker connectivity tips](#).
- If you are having issues seeing your iClicker points, check out this [troubleshooting guide](#).
- Find answers to many of your questions and contact the iClicker Tech Support Team by visiting [iclicker.com/support](http://iclicker.com/support) at any time.