Objective: To study classic and modern techniques of chemical analysis, with an emphasis on understanding their foundation in the concept of chemical equilibrium. Gravimetric, titrimetric, and coulometric measurement techniques will be studied. The student will also be introduced to fundamental concepts in analytical spectroscopy, electrochemistry, and separations. The laboratory component of the course will allow the student to develop and refine their expertise in chemical analysis.

Instructor:
Dr. Shama Mirza  Office: KEN 2076  mirza@uwm.edu
Office Hours: Mondays from 1:30-2:30 pm or by appointment.

Class Schedule:

<table>
<thead>
<tr>
<th>Section</th>
<th>Days</th>
<th>Hours</th>
<th>Room</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEC 401</td>
<td>TR</td>
<td>11:00 AM-11:50 AM</td>
<td>CHEM 170</td>
<td>Prof. Mirza</td>
</tr>
<tr>
<td>LAB 801</td>
<td>TR</td>
<td>TBD</td>
<td>CHEM 385</td>
<td>TBD</td>
</tr>
<tr>
<td>LAB 802</td>
<td>TR</td>
<td>TBD</td>
<td>CHEM 395</td>
<td>TBD</td>
</tr>
<tr>
<td>LAB 803</td>
<td>MW</td>
<td>TBD</td>
<td>CHEM 385</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Pre-requisite: C or better in Chemistry 104. Note: "Waivers" for the pre-requisite will not be issued.

Course Materials: (note that all items except "b" are required)
(c) Laboratory Manual for Chemistry 221 (available on D2L)
(d) Student Lab Notebook (100 carbonless duplicate sets; spiral-bound), Hayden-McNeil (2015) [ISBN-10: 9781930882744]
(e) a scientific electronic calculator (for quizzes, exams, and laboratory data analysis); you cannot use the calculator on your cell phone or a graphing calculator for any quiz or exam.
(f) approved safety goggles (required in the laboratory)
POLICIES.

Department of Chemistry. You are expected to fully understand the policies posted on the bulletin boards across from Room 195 and adjacent to Room 164. University policies can be found at: uwm.edu/secu

Academic Dishonesty. Academic dishonesty will not be tolerated. Cheating on an examination or any other graded material will result in a grade of zero as a minimum consequence. Failure in the course and referral to the University Judiciaries may also occur, depending on the severity of the offense. The University's policy is discussed in UWS Chapter 14 and Faculty Document No. 1686, which can be found at http://uwm.edu/academicaffairs/facultystaff/policies/academic-misconduct/.

Attendance. You are responsible for all material presented in lecture and laboratory. If you miss a lecture, you are solely responsible for obtaining the lecture material. Unexcused absences from a lab session will result in zero points for that week’s graded material. Legitimate absences can be made up during the next “Improvement Lab”.

Note: if you will need accommodations to meet any of the requirements of this course, contact me as soon as possible.

COURSE STRUCTURE.

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Mid-Term Exam I</td>
<td>15%</td>
</tr>
<tr>
<td>Mid-Term Exam II</td>
<td>15%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Lab Reports</td>
<td>30%</td>
</tr>
<tr>
<td>TA Evaluation</td>
<td>5%</td>
</tr>
</tbody>
</table>

Your course grade will be determined from the following elements:

Problem sets will be assigned weekly but will not be graded. Quizzes, based upon recently assigned problems, will be given by your TA during the Discussion period (i.e., during the second scheduled lab session). Mid-Term Exams will be given on February 22nd and April 5th during lecture time. The last day of "classes is May 10th; the Final Exam will be 10:00-Noon on May 15th. There will not be alternative times to take these exams.

Absences. There are not any “make-up” exams, quizzes, or lab experiments. For a scheduled absence (e.g., University athletics, music, etc.), Dr. Mirza must be notified in writing at least 48 hours prior to the absence. For medical absences, a written letter to Dr. Mirza signed by a licensed physician is required. If an exam or quiz or lab is missed for reasons not approved beforehand by Dr. Mirza, a grade of zero will be given. For an excused absence from a quiz or exam, the grade on the next quiz or exam will count double. Excused absences from laboratory sessions will be made up as the next "Improvement Lab". A lab that is missed unexcused cannot be made-up as an “Improvement Lab”. Late lab reports can be submitted but at a penalty of 5%
per calendar day. If you miss the Final Exam for any reason (i.e., other than a legitimate excuse), you will receive an "F" for the course (regardless of how many points you have at that point).

**OUTLINE of LECTURE TOPICS**

Chemistry 221    Spring 2018    Prof. S. Mirza

*Exploring Chemical Analysis* by D. Harris (5th Ed.)

Introduction............................................................................ Chapters 0, 1, 3

Chemical Equilibrium.................................................................. Chapters 6, 12 (1, 2, 3)

*Primary or “Classical” Techniques:*

Precipitation: Gravimetry & Titrimetry.................................... Chapter 7
Monoprotic Acids & Bases: Titrimetry.................................... Chapters 8, 9, 10
Polyprotic Acids & Bases: Titrimetry.................................... Chapter 11
Complexation: Titrimetry...................................................... Chapter 13
Redox: Titrimetry................................................................. Chapters 14, 16
Coulometric Methods............................................................. Chapter 17 (1)

*Secondary or “Instrumental” Techniques:*

Introduction to Electrochemical Methods................................. Chapters 15, 17 (2, 3)

Potentiometry & Voltammetry

Introduction to Spectroscopic Methods................................. Chapters 18, 19

Absorption Spectroscopy

Introduction to Separation Methods...................................... Chapter 21 (1, 2, 3)

Elution Chromatography

Laboratory.

There are ten experiments and three “Improvement Labs”:

Structure of the second lab period:

*Hour #1 — lab work carrying over from the first lab period
*Hour #2 — lecture on data treatment (statistical methods) & homework problems
*Hour #3 — quiz followed by a discussion of topics of interest
Advice ...

This course covers a large amount of material in relatively few lectures. The amount of reading and problem solving is significant. Assigned readings and problems will be made prior to the lecture on a particular topic. You are expected to read the material before each lecture and should not expect all assigned material to be covered in class — I will spend more time on the concepts that I have found students to have more difficulty in grasping. A wise approach is to read the required pages in the text and at least try to complete the assigned problems. The goal is for you to get a general idea of the material before I discuss it in lecture. Write down questions that you have and note things that you do not understand; then bring your questions to lecture or office hours for clarification. Studying the material in this manner will eliminate the need for cramming before exams — a hopeless task given the pace and scope of the course. If you are having trouble with the material, you must ask for help as soon as possible! The Teaching Assistants and I are eager to help you. Tutors are also available from the Chemistry Department.

The lecture and laboratory parts of the course will be integrated as much as possible and lab will be a significant part of the final grade. The coordination of the material for every week will not be ideal — it is inevitable (as you know from other science courses) that the lecture material will not always correspond to the lab experiment for a particular week. The lab comprises 35% of the total points so your performance in the lab is crucial to your overall grade for the course.