**Quantitative Analysis (CHEMISTRY 2270-1 and 2270-2 (Lecture/Lab Combined Course) Syllabus**

**Spring 2021**

**Instructor**: Dr. Balasingam Murugaverl (Dr. Verl)

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**Teaching assistant for laboratory**: Maxwell Freeman

**Lecture**: Online Zoom lectures, 11:00 AM – 11:50 AM MWF.

**Laboratory**: In person. Lab sessions will start in Week 1. Section 1 lab meets Monday 2:00 - 4:50 PM and Section 2 lab meets Tuesday 2:00 - 4:50 PM.

Office Hours: Will be determined on the 1st week.

**Textbook**:

There is no specific textbook for this course because textbooks are just reference material. Material covered in this course can be found in any quantitative analysis textbooks or reliable web sites.

**Materials Provided by Instructor**:

Course materials will be distributed on Canvas. Power Point Presentation of the summary of concepts covered in the lectures will be available on Canvas. The power point presentations are just prelude to the extensive and detail coverage of the topics in the lectures. Laboratory schedule and experiments for the laboratory will also be posted on Canvas.

**Course Description**: Analytical applications of solution chemistry.

**Number of Credit Hours**: 4 Quarter hours; 3 hours lecture and 1 hour of laboratory. A single grade is given for both laboratory and lecture.

**Course Prerequisites**:

This course builds upon and follows General Chemistry I, General Chemistry II, and Chemistry of the Elements. CHEM 2270 assumes that you have a good conceptual understanding of material covered in all three of these courses. It is not the grade you received; it is the knowledge at your disposal. This course requires significant proficiency with your basic mathematical aptitude. You will need to be able to do algebraic manipulations relatively well.

**Course Overview**:

When you learn how to do something, you have a skill, all you can do is use it the same way over and over. But when you understand how something works, you can reason and expand upon them infinitely, you simply own it intellectually. Chemistry is an experimental science and all the theories and concepts that the students learn in the lectures originated from attempts to explain experimental observations. The reason many people find chemistry difficult is because they do not fully understand the fundamental concepts. Contrary to what you have been led to believe, chemistry is NOT learned by memorization, practice problems or homework problems. **Practice does not make perfect in chemistry**. Developing logic and reasoning skills are essential for the understanding of chemistry. This demands a higher level of thinking and the purpose of this course is to is to provide

students with an in-depth knowledge of the principles and applications of chemistry. I do not believe in any gimmicks like clickers or online homework, they simply do not enhance student understanding of chemical concepts. Chemistry is about how well you can apply concepts to solve real life problems, not how well you can do exam problems. If you are accustomed to plug and chug method in Chemistry and your learning is based on memorization and practice problems this course will not be a good fit.

**Course Objective**:

To provide students with a more in-depth understanding of the basic concepts and theories of the topics discussed in the first year of chemistry courses and to apply the knowledge with critical thinking to solve real life chemistry problems at an advanced level. The student will develop an appreciation for chemistry as it relates to the other disciplines and will recognize how chemistry provides solutions to contemporary, historical, technological, and societal issues.

**course delivery in an online format**:

Although this is an online course, I will make every effort to make it fell like a regular in person lecture. The lectures will be live on ZOOM and will be recorded. I prefer feedback type lectures and encourage students to ask questions during the lecture. We may need to adjust or change, either to content or course procedures, as circumstances warrant. I pledge to uphold the standard integrity of this course despite the state of affairs.

**Exams:**
**All exams are essay type and administered online via Canvas. There will be a 24-hour window to take the exam.**

**a)** There will be two one-hour exams and a final exam. **There will not be any make up exams under any circumstances** and your final grade for the course will be determined by your performance in **all the three exams and the Lab**. If your score in the final exam is higher than any of the scores in the one-hour exams, the final exam score will replace the lowest score.
**b) All exams are comprehensive, encompassing lecture and laboratory material. The exams are designed to test your ability to apply the concepts covered in the lecture.**
**c)** *Raw exam scores will be posted on Canvas and does not reflect your actual grade. I will do statistical analysis on the overall performance of the class in each exam and discuss the grade distribution in the lecture.*
**d) I reserve the right to adjust the posting and due dates of exams to make allowances for the progress of the class.**
**e) All exams are nonnegotiable documents. I will be the judge of the right and wrong answers.**
**Lab:**
Although separate, the lab is an integral part of this course. Your comprehension of the material covered in the laboratory will be tested via the exams given in the lecture course.

**Grading:**
The breakdown of the course grades is as follows:

| | |
|---|---|
| Lab | 200 points |
| Exam 1 | 200 point |
| Exam 2 | 200 points |
| Final Exam | 200 points |
| TOTAL | 800 points |

## Tentative Schedule of Lecture Topics

| Date | Day | Topic |
|---|---|---|
| 3/31<br>4/2<br>4/5<br>4/7<br>4/9 | W<br>F<br>M<br>W<br>F | **Analytical Process**<br>• introduction to the analysis of real samples; sample handling and preparation, quantitative transfer, and elimination of interferences.<br>**Statistics**<br>**https://sites.chem.utoronto.ca/chemistry/coursenotes/analsci/stats/LinRegrMain.html**<br>• significance of the random and systematic errors, ways to minimize them, basic statistical evaluation of errors (standard deviation, variation, t-test, Q-test), application of statistics to data treatment and evaluation using spreadsheets.<br>• concept of gravimetric analysis including experimental aspects. |
| 4/12<br>4/14<br>4/16 | M<br>W<br>F | **Chemical Equilibrium**<br>• principles of titrimetric methods of analysis, with emphasis on dilution of solutions, equivalence, titration curves for complex acid/base systems, precipitation titrations, oxidation/reduction titrations, potentiometric titrations, and complex-formation titrations. |
| 4/19 | M | **Exam 1, Online (90 minutes)** |
| 4/21<br>4/23<br>4/26<br>4/28<br>4/30<br>5/3 | W<br>F<br>M<br>W<br>F<br>M | **Continue Chemical Equilibrium**<br>**Activity and the Systematic Treatment of Equilibrium**<br>• Ideal and non-ideal solutions; hydrated ions, ionic atmosphere, ionic strength, activity of ions, and application of the Debye-Huckel equation to thermodynamic equilibrium constant.<br>• concept of equilibrium as it applies to complex systems. |
| 5/5<br>4/7<br>5/10<br>5/12<br>5/14 | W<br>F<br>M<br>W<br>F | **Electrochemistry**<br>• principles of electrochemistry; electrode potentials, ion selective electrodes, the Nernst equation, and the theory of potentiometry, electrogravimetry, coulometry, voltammetry. |
| 5/17 | M | **Exam 2, Online (90 minutes)** |
| 5/19<br>5/21<br>5/24<br>5/26<br>5/28<br>6/31<br>6/2<br>6/4<br>6/7 | W<br>F<br>M<br>W<br>F<br>M<br>W<br>F<br>M | **Modern instrumental techniques**<br>An overview of spectroscopy, mass spectrometry, and chromatography.<br>• basic principles of spectrochemical methods; ultraviolet and visible absorption spectroscopy, atomic absorption spectroscopy, and the application of Beer's Law.<br>• concepts of chromatography; Theoretical plates, van Deemter equation, liquid and gas chromatography, response factors.<br>• Basics of Mass spectrometry. |
| 6/8 | Tue | **FINAL EXAM, Online (3 hours)** |