# Syllabus for Chemistry 214
# Quantitative Analysis Laboratory

Quantitative Analysis Laboratory (1 credit hour)
Prerequisite: Chem 106/102 and 112; Chem 222/224 and 226 as well as completion of lecture Chem 212.

**Instructor:** Dr. Conrad Naleway
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Office Hours:  During, Just Prior and After Lab

**Teaching Fellows**: Katrina Binaku & Jeff Raffaelli
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Laboratory Hours:   MW 2:45-5:30 or TTh 2:30-5:20
TA Office hours: TBD, Available on Blackboard

**Other Materials:**
You will need one bound (NO SPIRAL) laboratory notebook such as a national-brand composition book; available in any bookstore.  You also need an inexpensive calculator having logarithm (base 10 and e), exponential, and trig functions.  Lab goggles are also required to be worn in the lab at all times.  All items must be brought to every lab session.  In some instances it may be advantageous to have a laptop computer in lab for data entry, analysis and calculations.  If it is deemed to be a distraction or hazard, the TA or Lab Instructor may request that it be put away. Note: Cell phones are not a substitute for a calculator and will NOT be allowed for use during quizzes, the midterm, or final exam.

**Objectives:**
1) To acquaint students with some of the classical and modern techniques in analytical chemistry
2) To teach wet chemical lab skills, efficiency and planning of experiments
3) To teach critical evaluation of experimental results
4) To become familiar with conventional data collection in commercial and academic laboratories.

**Laboratory Procedures:**
The instructor will explain the procedures and goals for each assignment prior to its execution.  You will be given handouts that are pertinent to each lab assignment beforehand.  The instructors will explain during the first lab period of the semester how the notebook is to be written.  The notebook must contain all data and calculations assembled during each experiment.  It should be organized but not necessarily perfect and thus can contain strikeouts and must be done in PEN.  Students must come prepared to lab to optimize their efficiency in the lab. This will require that each student introduce in their notebook a summary of the lab procedure basically helping them get started.  The TA and/or Lab Instructors will review and sign off on this portion of the lab notebook and will prevent the student from starting the lab if it is not satisfactorily completed.

In most cases, you will be assigned a standard unknown sample whose composition is known to at least **FOUR** significant figures.  You will determine the concentration of your unknown sample and be graded on how accurately your determinations reflect its true composition.

For each assignment, you will report the values of your individual determinations, the mean concentration (or percent composition) and the standard deviation associated with the overall determination.  You will be permitted to repeat each lab only once as time permits in order to get a better grade.  However, you will need to analyze a new unknown sample and it must be undertaken in the time frame established on the laboratory

schedule.  In order to accomplish this, you will need to report your results and calculations on BLACKBOARD as soon as completed.  You will then be graded on the accuracy of the results and can thus decide if you want to repeat the experiment.  Graded accuracy will determine about 60% of your overall grade (see breakdown below).

Laboratory reports are to be computer generated and must follow the suggested format handed out during the first class period.  All (both if a redo was performed) data sets must be included in your final laboratory report.  The lab report will thus contain the data from the first attempt and second if repeated.  Final accuracy will be determined by the better of the two reported findings.  Graded lab reports will determine 22.5% of your overall grade (see breakdown below).  **Lab reports turned in late will receive a penalty of 10% each day the report is late and result in a grade of 0 if not received within one week of the established due date.**  Lab reports **will not** be accepted via email unless otherwise specified.

There also will be two exams which cover materials in each of the immediately preceding experiments.  The midterm exam will include **Experiments 1-3** and the Final Exam will include **Experiments 4-6**.  The questions will cover the theory as well as related calculations.

Lab Quizzes will also be a part of the overall grade.  **Before the start of each experiment a quiz will be given asking questions in regard to the procedure and calculations to determine preparedness for the lab.  Quizzes will be given during the first 15 minutes of lab.  Thus you MUST be punctual in getting to lab on-time, there will be NO excuses! If you arrive late to lab, you will NOT be allowed extra time to complete the quiz.**

Finally, a portion of the overall grade will be eared from an exercise utilizing Excel.  An assignment will be designed to familiarize the student with Excel and the role it can play in data collection, organization, and analysis.  While this exercise may be contrived, it is important that the student be familiar with the usage of a program such as Excel if he or she has any intention of further work in the sciences, be it other undergraduate level classes, graduate school, and/or a career in the sciences.

**Grading Policy**
The grading policy established here is subject to change at the discretion of the Professor and/or the Teaching Assistant.

| Grading Category | Pts | Percent |
|---|---|---|
| Analytical Findings (Accuracy) | **1200** | 60 % |
| Detailed Laboratory Reports | **450** | 22.5 % |
| Lab Quizzes | **90** | 4.5% |
| Excel Exercise | **60** | 3% |
| Midterm exam | **100** | 5% |
| Final exam | **100** | 5% |
| Total | **2000** | 100.0% |

## Grade Assignment:

| Points | |
|---|---|
| **1800 - 2000** | **A** |
| **1600 - 1799** | **B** |
| **1400 - 1599** | **C** |
| **1200 - 1399** | **D** |
| **Below 1200** | **F** |

**Academic Honesty**
Please review Loyola University Chicago policy on Academic Integrity through the following link:
http://www.luc.edu/academics/catalog/undergrad/reg_academicintegrity.shtml

# Lab Report Format and General Guidelines
## CHEM 214: Quantitative Analysis Laboratory

Lab reports for Quantitative Analysis should be more complete, accurate, and detailed than reports done in the past for General Chemistry or Organic Chemistry.  This is an upper division level science class, and more thoroughness is expected of the student.

**Lab reports consist of the following elements:**

**Title page** – lab experiment name and number centered; your name, lab partners name (for partner labs only), and date the report is due in the lower right hand corner of the title page

**Purpose** – brief statement of the reason for performing this experiment

**Materials** – two separate lists: one for a listing of all equipment (including the balance used) and the second list for chemicals used (including any unknowns, but excluding any solutions the student makes)
- Concentrations of solutions used should be included.  Include concentrations of stock solutions, not concentrations of solutions made.  Concentrations of solutions made should be given under the results section.

**Procedure** – this is a list of all the steps that you did to perform the lab, including any changes that you may have made to the original printed procedure.
- This can be summarized from that listed in the lab handouts but must be rewritten in your own words*! Do not plagiarize*
- It must be so clear that anyone not familiar with the lab would know exactly what to do.
- It should not contain the actual masses, volumes, etc. used by the student.
- Be careful how you write your prep instructions for solutions.  You will dissolve/dilute chemicals in a volume smaller than what the final volume will be and then dilute to the final volume mark.  For example: Dissolve 12 g KOH in 300 mL DI water, dilute up to 500 mL mark, and shake to mix well.

**Results** – list data obtained, such as volumes measured, weights, temperatures, in a table format
- Multiple trials must always be done to verify data as having good precision.  All data must be shown, including repeat lab data.  Teaching assistants will grade lab reports based on precision.
- Data must be represented in table format with appropriate column and row headings and include the individually determined values, averages (for concentrations, percents, unknowns, etc.), standard deviations, and other necessary values. When applicable include units in column headings i.e. "NaOH volume (mL)" or "mL of NaOH." Tables must be labeled with appropriate <u>brief</u> titles describing the contents within a table.
- Statistical analysis of your data should also be put in this section.
- If applicable, graphs should go in this section, and they must be clearly labeled with a title and proper x axis and y axis names as well as units.  Graphs should be done in Excel.

- Include calculations in this section labeled appropriately with units, chemicals and properly identifying what is being calculated and the trial # the calculation is being completed for.
- Include general equations corresponding to each calculation necessary i.e. general equation for **dilutions** (see example below), average, standard deviation, ppt, to name a few.
  (ex.: Calculation for volume of HCl for 0.1M HCl). The calculations may be written, but please write them neatly so they can be read and understood.
  - Show an outline of equation being used and at least one example with your numbers
  - ex.: $m_1v_1=m_2v_2$        12 M$(v_1)$=0.1M(1000 mL)   $v_1$=8.33 mL
  - Please utilize leading zeros before the decimal point (0.1 mL and not .1 mL).
- A paragraph statement of the results must also be present to interpret/summarize the data shown in tables and graphs.
- If graphs or figures are included, such as spectra or chromatograms, they should be accompanied with a proper label i.e. Figure 1, and brief description directly below it.

**Conclusion** – a restatement of your results, and what the results mean
- Include a **detailed** analysis of error (at least 3 errors). This should be done based on the students own data and results. An analysis of error can also be done on theoretical errors as well though the student may not have made these errors.
  - How does the error change the outcome (concentration higher/lower than it should be, etc.)? How does the error affect the subsequent steps in the experiment?
- How can the experiment be improved and/or made simpler?
- How can the student's technique be improved?

**Additional Considerations**
- Order is also important for excellent scientific work – the lab report write-up should follow the order listed on these directions.
- Lab reports should have page numbers specifically located in the bottom center of each page.
- All parts of this report must be typed (calculations are an exception). Please use at least 11 point font, 1.5 lines spacing for paragraphs, and 1 inch margins.
- Please keep entire tables on a single page. If you must split up a table, remember to include column and row headings again.
- Reports should have good spelling, sentence structure, etc. Do not use run-on sentences, sentence fragments, or misspelled words. Do not use personal pronouns (I, we, me, etc.).
- Take the time to check over your work and re-read your report to make sure that what you wrote is clear and makes sense.

**The following has been said:**
- A student could do mediocre work and write up an excellent lab report, and the work will be thought of as wonderful. A student could do wonderful work and write it up poorly, and the work will be thought of as mediocre.

The lab report write-up is a **VERY IMPORTANT** part of a laboratory based course, especially at the junior/senior undergraduate level and of course for graduate level work.

# Lab Report Grading Rubric

The following is a rough guideline of how points will be assigned on your lab reports.  All lab reports will be out of 50 total points.

| Lab Report Categories | Points |
|---|---|
| Title Page | 1 |
| Purpose | 3 |
| Materials | 5 |
| Procedure | 7 |
| Results | 13 |
| Conclusion | 16 |
| Grammar | 5 |
| **TOTAL** | **50** |