California State University-Los Angeles Quantitative Analysis – CHEM 201

CLASS SYLLABUS – Summer 2006

Instructor: Lecture: Dr. Gregorio Santillan, Phone (323) 343-2313, email: gsantil@calstatela.edu
Laboratory: Drs. Gregorio Santillan and Pavel Glukhovskiy
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Laboratory Assistants: &

Office Hours: Dr. Santillan P.S. 610 T & R 8-9 am, (also from July 5-Aug 9: MW 1-2:30 pm).or by appointment.
Dr. Pavel Glukhovskiy, P.S. 610 T & Th 12-12:40 pm

Lecture: T&Th 4:45-6:00 pm, PS 158

Laboratory: 02 T &TH 1:10-4 pm, P.S. 824
03 T & TH 6:30-9:20 pm, P.S. 824
04 T & TH 8-10:50 am, P.S. 824
05 M & W 12-2:50 pm, P.S. 824

Course Description:

CHEM 201 is a sophomore level course which introduces the student to principles and techniques in proper quantitative chemical analysis. The formal prerequisite is a full year of freshman chemistry [CHEM 101-3 or equivalent from other universities (Grade C or better)] and assumed that the students have a solid grasp of college level math including algebra.

Course Objectives:

The main objective of Chemistry 201, Quantitative Analysis, is to develop students' understanding of the principles of analytical chemistry. More detailed objectives include:

- ∑ To learn both classical and modern instrumental aspects of analytical chemistry;
- ∑ To learn the analytical process as applied to basic laboratory research;
- ∑ To become familiar and later master the elements of good laboratory practice;
- ∑ To ultimately apply his/her knowledge of analytical chemistry in an independent manner.

Required Textbook: Quantitative Chemical Analysis, 7th Edition, D.C. Harris, W.H. Freeman and Company, New York, 2007, http://bcs.whfreeman.com/qca/

Lab Handouts: Detailed handouts of each of seven laboratories and safety requirements will be provided by the instructor.

Learning Video:
"Chemistry" – has six sections and the Safety section and Pipetting section will be shown at the first laboratory meeting. Demonstration of the analytical balance will also be given.

Lecture presentation style: Overheads, chalk board, handout practice sheets, group problem solving

Tentative Lecture Schedule: Summer, 2004 ***Note: dates subject to change

Week	Dates	Subject	Chapter(s)
1	6/20, 22	Analytical process/ Basic review of concepts, Solutions and their concentrations, Stoichiometry	0, 1, 2
2	6/27,6/29	Experimental Error and Calibration	3, 4
3	(7/4 Holiday),7/7	Gravimetric methods of analysis	6, 27
4	7/11	Volumetric/Titrimetric analysis	7, 8
	7/13	**EXAM 1** (on material covered up to 7/8)	
5	7/18, 7/20	Spectrophotometry , calibration methods	18, 19, 20.1-20.4, 21 ,5
6	7/25, 7/27	Acid-base equilibria & titrations	9, 10, 11
7	8/1, 8/3	Complex formation and Redox titrations	12, 16
8	**8/8**	**EXAM 2** (material covered up to 8/3)	
	8/10	Electrochemistry & potentiometry	14, 15
9	8/15, 8/17	Analytical Separations, Gas Chromatography	23, 24
10	8/22, 24	HPLC, Capillary Electrophoresis	25, 26
	Aug 29th	**4:30-7 PM FINAL EXAM - comprehensive**	

Attendance all lecture classes is expected. Unannounced quizzes and group work are to be anticipated by all students. Absent students are responsible for all discussion and lectures they missed.

No makeup exams are given for the Midterm Exams. At the discretion of the instructor in cases of documented family emergencies and illness (with doctors excuse) only, a student may be excused. Under no circumstances will a student be excused from taking the test due to lack of preparation. In this case adjustments to the weighted average will be used.

Homework

Homework problems will be assigned at the beginning of each week and will be handed in at the **first laboratory period the following week** unless otherwise stated. Late homework: First lab -2, thereafter -1 each additional lab period. Homework should be neat and state the Homework # and the problems assigned at the top of the first page. Students should work these problems independently with all calculations clearly visible in a step by step manner on stapled paper.

HW#	Date due	Chapter	Problems

1	6/27	1 (p. 18)	7, 10, 11, 13, 14, 16, 18, 21, 31
		2 (p. 37)	1,4,7,14, 15, 18, 22, 24
2	7/6	3 (p. 51)	7 (a, c, d, f, g), 15, 21
		4 (p. 75)	11, 13, 14, 19
3	7/11	27 (p. 641)	15, 17, 18, 22
		6 (p. 117)	4, 8, 16, 19
4	7/18	7 (p.137)	7, 12, 14, 27, 34, 36
		8 (p. 155)	3, 6(a), 12
5	7/25	18 (p. 399)	6, 10, 12, 16
		19 (p. 418)	1, 3
		5 (p. 92)	2, 23, 29
		21 (p. 472)	5, 14, 19, 20
6	8/1	9 (p. 178)	8, 19, 35, 38
		10 (p. 196)	1, 5, 13, 28
		11 (p. 223)	17, 21, 47
7	8/15	12 (p. 246)	2, 7 (a,c,f,i), 32
		16 (p. 344)	2, 5, 14, 18
8	8/22	14 (p. 294)	16, 21, 25
		15 (p. 323)	3
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9	8/24	23 (p. 525)	9, 11, 13, 18
		24 (p. 553)	20
		25 (p. 585)	9
		26 (p. 624)	10

Laboratory work

Items required include: A scientific calculator, approved safety goggles, bound notebooks (quad-ruled composition book, bookstore), a 3.5 HD computer diskette. Students must inform their instructors in advance if a laboratory will be missed. Failure to do so may result in the student being dropped from the class. All laboratory work for this class must be performed in the quantitative analysis lab, not individual research labs. No switching laboratory sections unless approved by both instructors. For new unknowns, -5 points will be deducted. All unknown laboratory work will be graded based on overall precision and accuracy. No safety goggles, -5 points.

Quizzes

A written quiz will be given in the laboratory on the day that you are scheduled to start each unknown experiment. Quizzes will cover laboratory work assigned for the particular experiment to be completed. Typically, the quizzes test your knowledge of the chemistry involved as well as your ability to do quantitative analysis based on data given.

Flow Charts

A work outline (flow chart) with estimated times for each step in each experiment is required at the beginning of each lab and must be written in the left side of notebook before each new experiment (see notebook format below). Before getting unknown, students will be given an oral quiz on the information which should be in the outline.

Laboratory Notebook Format (no spiral notebooks will be accepted)

Record all experimental work in a stiff-covered, permanently bound notebook (National, # 53-110) and use the right hand pages of the notebook for the experimental records. Flow chart must be placed on left hand pages. The first two pages of the notebook are to be saved for Table of Contents. Pages must be numbered. All data must be written directly into the notebook with a date on every data page. No pencils, "white-out" of erasable ink may be used. If an error is made, simply place a single horizontal line through mistake and enter correction. Be sure to write down important procedures in lab book before each lab. No photocopies of manual or procedures in lab book. Always have your notebook in class for spot inspection or grading. **Note: Up to 5 points will be deducted for each violation of the above policies!**

Each experiment record and report must include the following:
1. Name, section #, date, quarter
2. Experiment title, and objective(s)
3. Principles: A concise description of the chemical principles (equations included).
4. Data and important observations (IN INK)
5. Calculation methods: At least sample calculations of all calculations must be included.
6. Results and discussion (graphs included)

Note: Points will be deducted for any missing information!

Note: Any balanced equations or mathematical expressions are to be put in the "Principles" section. The penalty for not having a lab book is **10** points. Outside of book must be labeled with name (printed), Chem 201, Lab section #, time of meeting, locker #, instructors name and Quarter taken. Lab books will be graded twice during the quarter (unannounced).

Informal Reports

Results of every unknown are to be handed in on the tear-out sheet in back of your experimental handouts at the beginning of the first period following the scheduled completion of experiments. -2 pts will be deducted for late reports on the first lab period after, and -1 for each additional lab period. Reports must include averages, standard deviations and relevant graphs (Excel or other graphing programs). Informal reports should be handed in before the formal report to access unknown grades. Be sure to include all data for each determination along with calculations and experimental set-up and label all graphs appropriately.

Formal Reports (***see last page for detailed descriptions of sections)

Three(3) formal, typed-written reports will be handed in during the course (experiments included will be announced by lab instructor). These reports must follow the format below. These reports will be due the next lab period after turning in the informal report for that same experiment. As with homework, -2 pts will be deducted for late reports on the first lab period after, and -1 for each additional lab period. Reports must be a concise description of the experiment with all appropriate data and graphs. The format includes (in order): **Formal reports will be required for the calcium (Ca) and acid-base (pH) titration experiments as well as the research project.**

1. Cover page with title of experiment, name, date, locker # and lab section
2. Abstract
3. Introduction
4. Experimental procedures
5. Results, including data and relevant graphs

6. Conclusion
7. References
8. Acknowledgments

Research project

Students have a choice of research projects based on the instructors overall choice of topic. However, projects must be within the constraints of the laboratory equipment and chemicals in the laboratory. Students should give the instructor a short procedure with list of equipment and chemicals for approval (by the end of the 6th week). Topic deemed appropriate will be discussed in lecture and handout will be provided during the 6th week.

Laboratory safety

The safety film you will watch on day one is vital and your attention is required. In addition, your lab instructor will show you where important safety items are located, i.e. eye wash, safety shower.
Some important points to keep in mind:

1. Safety glasses must be worn at all times in the lab
2. No food or drinks in the lab
3. No shorts or open toed shoes allowed
4. Work with concentrated acids and bases in the appropriate hoods
5. Report any accidents to laboratory instructor or assistant
6. Be aware of all safety demonstrations in video
7. Be aware of all exits and safety equipment including eye wash and fire extinguisher.

Laboratory etiquette

It is essential that you consider others in the lab. Be careful with acids and hot reagents and clean up any spills that may occur. Use of the analytical balances: Do not use weighing paper and never transfer samples in the analytical balance (points will be deducted). Keep your work areas clean and. Cleaning assignments will be given by instructor each lab period. You are expected to stay focused on your experiment. Cell phone activity should be kept at a minimum and outside the lab.

Laboratory Schedule of Experiments

	Expt #							
	1	2	3	4	5	6	7	8
Locker 1	**Ca**	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	pH	**Res. Proj.**
2	**Ca**	Fe	Cu (ASV)	Ni (Grav)	AA	pH	Mn	**Res. Proj.**
3	**Ca**	Cu (ASV)	Ni (Grav)	AA	pH	Mn	Fe	**Res. Proj.**
4	**Ca**	Ni (Grav)	AA	pH	Mn	Fe	Cu (ASV)	**Res. Proj.**
5	**Ca**	AA	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	**Res. Proj.**
6	**Ca**	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	**Res. Proj.**
7	**Ca**	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	pH	**Res. Proj.**
8	**Ca**	Fe	Cu (ASV)	Ni (Grav)	AA	pH	Mn	**Res. Proj.**
9	**Ca**	Cu (ASV)	Ni (Grav)	AA	pH	Mn	Fe	**Res. Proj.**
10	**Ca**	Ni (Grav)	AA	pH	Mn	Fe	Cu (ASV)	**Res. Proj.**

11	**Ca**	AA	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	**Res. Proj.**
12	**Ca**	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	**Res. Proj.**
13	**Ca**	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	pH	**Res. Proj.**
14	**Ca**	Fe	Cu (ASV)	Ni (Grav)	AA	pH	Mn	**Res. Proj.**
15	**Ca**	Cu (ASV)	Ni (Grav)	AA	pH	Mn	Fe	**Res. Proj.**
16	**Ca**	Ni (Grav)	AA	pH	Mn	Fe	Cu (ASV)	**Res. Proj.**
17	**Ca**	AA	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	**Res. Proj.**
18	**Ca**	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	**Res. Proj.**
19	**Ca**	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	pH	**Res. Proj.**
20	**Ca**	Fe	Cu (ASV)	Ni (Grav)	AA	pH	Mn	**Res. Proj.**
21	**Ca**	Cu (ASV)	Ni (Grav)	AA	pH	Mn	Fe	**Res. Proj.**
22	**Ca**	Ni (Grav)	AA	pH	Mn	Fe	Cu (ASV)	**Res. Proj.**
23	**Ca**	AA	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	**Res. Proj.**
24	**Ca**	pH	Mn	Fe	Cu (ASV)	Ni (Grav)	AA	**Res. Proj.**

Collaborative Experiment:

For both of the copper experiments (AA and ASV) you will be paired with another student. During the first experiment, one student will be the manager and one the assistant. The manager will oversee the assistant's work and will report on the experimental success of this student in his/her own report and laboratory notebook. On the next experiment, the assistant will become the manger and do the same. This collaborative exercise will help students in gaining valuable laboratory management practices. For once, you will be the instructor!

The objective is for you to critique the quality of other students work. Be professional and critical and a simple half-page narrative will suffice. Include in your narrative the following: the student's laboratory technique, attention to detail, following of safety rules and overall performance.

Point Distributions for Grades

Lecture: 2 x 100 point exams
Comprehensive final exam 250 points
Total = 450 points

Laboratory: Unknowns 7 x 35 points
Formal report 2 x 25 points
Research project 50 points
Laboratory notebook 55 points (25 first grading, 30 second grading)
Quizzes 70 points
Homework 80 points
Total = 550 points (1000 comprehensive points)

Grades will be assigned as traditional (A, B, C, D, & F) and based on points accumulated. However, class attendance, distribution of points and individual performance will be taken into consideration on final grades. To pass this course, students must complete all laboratory work. Students will receive an (F) if laboratory work is not completed (unless a documented excuse, e.g., medical).

Dropping the course/Incompletes

Hopefully, a student will not be dropping this course. However, in the event that this is necessary the student must meet all university rules and deadlines. In addition, the student must check out the laboratory at the time he drops the course and during the normal lab period. Lockers not properly checked out will result in the student being charged a $10 fee in addition to broken or missing equipment.
In the case of an incomplete, the student must be making a (C) in the course and the reason for the incomplete an illness or an accident. An INCOMPLETE GRADE REPORT form must be completed and given to the instructor by the end of the examination week.

Final Comments

This is a challenging course and requires a good deal of time for laboratory preparation and lecture problem solving. Keep up with all lectures and homework and follow all laboratory experiments closely (flow chart will help you). If you have questions, ask. Finally, relax and enjoy the course.

Formal Report Sections – Detailed Description

Abstract

A summary of the technique and contains key results. No background material should be included here.

Introduction

Here one states the aim, the historical and theoretical context of the work. Include any relevant chemical equations or reactions. Should be concise, but have enough information for a complete introduction. It is important to describe the chemistry (chemical equations) as well as the mathematical equations and formulas that will be used. Showing molecular structures is recommended whenever appropriate.

Experimental Procedures

This section is used for describing experimental procedures, conditions, apparatus and reagents used in the experiment. Do not use outline form. Paraphrase the instructions in the manual in your own words.

Data

The raw data obtained in the experimental section is presented here.

Analysis and Results

The data listed in the data section is analyzed by calculations or graphs in this section. Final results are tabulated for easy perusal. Show all calculations carried out including mean and standard deviation.

Conclusion

This section contains a critical evaluation of the data gathered and the errors inherent in them. Be specific and thorough in your narrative.

References

Throughout the body of the manuscript, statements used which derive from external sources require defense based on previous work. These statements must be denoted numerically either with a superscript or in parenthesis in the text, and then the source listed in the Reference section by that number.

For example:

1. J. Peabody and H. Originales, "The Behavior of Copper Ions in Aqueous Solution." Journal of Analytical Results, **21**, 345-350.

Acknowledgments

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