CHE 300 ANALYTICAL CHEMISTRY
Fall 2006
Marian College
3200 Cold Spring Road, Indianapolis IN 46222

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Office Hours: MWF 10.00-10.50 am R 2.00-4.00 pm and by appointment
Lecture: 3 semester hours 11.00-11.50 am MWF Room 355
Laboratory: 2 semester hours: 1.30-4.20 pm MW, room 356

Course Description: Study of the theory of measurement, error, and statistics; solution chemistry and titrations; electronalytical, chromatographic, and spectrophotometric methods.

Textbooks: Quantitative Chemical Analysis, Daniel C. Harris, 7th Ed., W. H. Freeman, 2006.

Other needs: Hardbound laboratory notebook, scientific calculator.

Course Summary: CHE 300 is a required course for chemistry majors and a recommended course for science majors with an interest in laboratory careers. The course follows on from the aqueous equilibrium chemistry presented in CHE 152 with emphasis on quantitative methods. The theory of chemical analysis is presented in the class, and reinforced by practical analysis carried out in the laboratory. Both "wet" chemistry (gravimetric and volumetric analysis) and instrumental methods (chromatography, spectroscopy) are included.

CHE 300 is included in the General Education Program because successful attainment of the Course Objectives (below) contributes to attainment of General Education objectives in the areas of Scientific and Quantitative Understanding and of Effective Communication. Particular areas include:

1. Scientific (empirical) method of problem-solving and inquiry.
2. Fundamental laws of nature and their significance.
3. Mathematical reasoning, techniques of understanding numerical data, computer literacy.
4. Critical, analytical, and creative thinking skills in written and oral communications.

Assessment of the Course Objectives is through (1) 3-4 semester tests and a comprehensive final examination, (2) written laboratory reports and an investigative project laboratory. Laboratory reports will be more detailed than those required for CHE 151 and CHE 152, and feedback will be available at the draft stage to help you produce the best report possible.

Course Objectives: The main goals of this course are to cultivate demonstrable laboratory skills together with understanding of the underlying theory and related data analysis methods, including:

1. correct technique in the use of laboratory instruments,
2. the ability to take experimental data of high quality,
3. the ability to carry out calculations and error analysis on these data and produce quantitative results,
4. the ability to keep a clear and accurate laboratory notebook, and
5. the ability to design, carry out, and report the results of an independent chemical analysis,
6. the ability to manipulate symbolic expressions (algebraic and chemical equations),
7. the correct use of sign, significant figures, and unit labels, and
8. the use of relevant computer software to facilitate data analysis.

Laboratory Experiments: The experiments are largely taken from the materials accompanying *Quantitative Chemical Analysis*, which may be downloaded from http://bcs.whfreeman.com/qca7e. Additional supplementary materials, including quizzes and problem solutions, are also available from this site.

Tentative list of experiments:

1. Calibration of laboratory glassware.
2. Gravimetric determination of Ca.
3. Preparation of standard acid and base.
4. Statistical evaluation of acid-base indicators.
5. Acid-base titration: the Gran plot.
7. EDTA titration of natural waters.
8. Synthesis and analysis of ammonium decavanadate.
9. Iodimetric titration of vitamin C.
10. Spectrophotometric determination of Fe.
11. Spectrophotometric determination of an equilibrium constant.
12. Spectrophotometric analysis of caffeine and benzoic acid.
13. Mn^{2+} standardization by EDTA titration.
14. Measuring Mn^{2+} in steel by atomic absorption spectroscopy.
15. DNA analysis by high performance liquid chromatography.

Course Requirements and Assessment Method:

1. Laboratory reports should be in ink and written assignments should be word processed (and spellchecked). Laboratory reports are due one week after the experiment.
2. There will be 3-4 tests and a comprehensive final exam. The final exam will be in two parts: an open-book short question exam will be held on Wednesday, December 13, from 10.00 to 11.30 a.m., and an open-book exam with longer problem-type questions will be assigned approximately one week beforehand and be due on the day of the exam. All exams must be taken on the scheduled days unless there is a valid reason not to take the exam at that time. If you miss an exam for

a valid reason, the exam must be taken as soon as possible after the scheduled day.

3. You are expected to keep a laboratory notebook. This will be a dated record in ink of all work that you carry out in the laboratory. Keeping a notebook containing a full record of your data as you obtain them is considered to be an important part of your academic honesty as a scientist. Notebooks will be examined periodically throughout the semester, and a final notebook grade will be given based on organization, clarity, and completeness.
4. Unless stated otherwise, you will carry out all laboratory analyses in triplicate, and turn in the three answers, together with their average and standard deviation. The relative error in the three analyses will determine the grade. If the grade for a particular analysis is low, you may repeat the analysis. In cases where the analysis is on a standard sample, the grade will be based on the relative error between your result and the manufacturer's standard result.
5. You are encouraged to participate actively in class by reading the relevant material beforehand, asking questions, and taking notes. Ideally, the class should form a fertile environment for mastery of chemical ideas. Chapter outlines and problem assignments for each chapter will be handed out beforehand. You are encouraged to form study groups and meet regularly and review the material.
6. Mathcad and LoggerPro will be used to assist data taking and analysis.
7. There will be an independent research laboratory on a topic chosen from a list to be given later.
8. Peer tutors may be available.
9. You are expected to understand and adhere to the College's policy on academic honesty.

Attendance:

Regular attendance in lecture and laboratory is important for your learning and for maximizing your interaction with the instructor and with others in the class. This will be reflected in a grade penalty of approximately one partial grade per three absences from lecture, and one partial grade per absence from lab. Unavoidable absences (for example due to illness) will be considered differently from unexcused absences. Therefore, you must inform the instructor of the reasons for your absence promptly. An *unexcused* absence from laboratory will lead to a grade of zero for that laboratory.

Lateness is disruptive to the classroom environment and inconsiderate to your fellow-students. Repeated lateness will result in a grade penalty.

Grading Criteria:

6. The overall grade is calculated as follows:

Homework, class tests, and assignments:	30%
Final exam:	30%
Laboratory:	40%

   The letter grading scale follows common standards, with >90% corresponding to A, 80-89% corresponding to B, 70-79% corresponding to C, 60-69% corresponding to D, and <60% corresponding to F. The marks may be curved if needed. There is no such thing as extra credit.
7. The results of laboratory analyses will be presented in the form of laboratory reports. These are expected to be clearly written or typed, thorough, and well-structured, with a detailed presentation of calculations, numerical results, and statistically-calculated errors.
8. The results of the independent research laboratory must be presented in a written report, which should be word processed and should be checked by the Writing Center before being handed in. The data analysis should make use of computer-based methods. The report will be graded on the statement of the problem, the correctness of the calculations, the presentation of the results, and the validity of the conclusions. Additionally, the results should be presented orally to the class.