Lehman College
City University of New York
Department of Chemistry

Quantitative Analysis CHE-249
Fall - 2018

Instructors: Marc S. Lazarus,
Office Hours:
Office: Davis Hall 336
Telephone: (718)960-8843
e-mail: marc.lazarus@lehman.cuny.edu

Course Description

8 hours (2, lecture; 6, lab), 5 credits. Fall term only. Principles of gravimetric, volumetric, and spectrophotometric analysis. Methods involving acidimetry, precipitation, chelation, oxidation, and iodometry. Analytical separations. PREREQ: CHE 168-169.

Place of course in degree program

This laboratory is a degree program requirement for the Chemistry, and Biochemistry majors. This is also the elective course recommended for Chemistry minors.

Academic or Learning Objectives

Student Learning Outcomes: After completing this course students should be able:

a. to make precise and accurate measurements using physical and chemical equipment and instruments.

b. to understand the fundamental concepts of analytical chemistry.

c. to use the mathematical and statistical analysis to assess the precision of the measurement.

d. to apply appropriate analytical techniques to obtain quantitative chemical in formation from unknown samples.

Required Readings

Fundamentals of Analytical Chemistry, Ninth Edition, by Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch, Brooks/Cole, Cengage Learning, Belmont, CA, 2014.

Course Requirements and Grading

A student's grade in the CHE 249 class will be determined from a combination of grades given for laboratory reports with grades obtained from three lecture exams. The student's laboratory report grade will be determined by averaging the grades obtained by the student on the eight laboratory reports. The student's lecture average will be determined by averaging the grades from three lecture exams. A regular two hour final exam will be given in the course. The student's final grade will be calculated by summing 50% of the laboratory report average with 20% of the exam average and 30% of the final exam grade.

Attendance Policy

The attendance to the laboratory is compulsory. A student cannot miss more than TWO laboratories. For the case of missing more than two laboratories the student will not receive a passing laboratory grade. **No make-up laboratories will be given. This is in accordance with the chemistry department's policy.**

Accommodating Disabilities

Lehman College is committed to providing access to all programs and curricula to all students. Students with disabilities who may need classroom accommodations are encouraged to register with the Office of Student Disability Services. For more information, please contact the Office of Student Disability Services, Shuster Hall, Room 238, phone number, 718-960-8441.

The Science Learning Center (SLC)

The Science Learning Center (SLC) is the tutoring center on campus. The SLC provides drop-in tutoring for natural and computer science courses. To obtain more information about the SLC, please visit their website at http://www.lehman.edu/issp, or please call the ACE at 718-960-8175,

Classroom Policy:

Food policy: FOOD and **DRINKS** are **STRICTLY PROHIBITED** in the chemistry laboratory.

Electronic devices Policy: No electronic devices can be used or kept accessible during exams or quizzes; this includes, but is not limited to i-Phones, smart watches, google glasses, cell-phones (any type), beepers, iPods, MP3 players, tape-recorders, PDAs, **bluetooth** and other computing or music devices. Only **basic scientific** calculators will be allowed. **Graphing Calculators are not acceptable**.

Required Equipment (to be provided by the student)**:** padlock; detergent; paper towels; matches

SAFETY GLASSES MUST BE WORN AT ALL TIMES IN LABORATORY! The students without **SAFETY GLASSES will be not allowed to work in the laboratory**

Academic Integrity

See the Lehman Undergraduate Bulletin.

Course topics

The following topics will be covered:
Measurements and Statistics, Calibration, Chemical Equilibria, Titrations, Electrochemistry, Spectrometry, Analytical Separations.

COURSE LECTURE OUTLINE

No.	Subject
1.	Chapter 4 Calculations Used in Analytical Chemistry - Units of measurement - Solutions and their concentrations - Chemical Stoichiometry
2.	Chapter 5 Errors in Chemical Analysis - Precision and accuracy - Systematic errors Chapter 6 Random Errors in Chemical Analysis - The nature of random errors
3.	- The population standard deviation - The sample standard deviation - Variance and other measures of precision - Propagation of random errors - Reporting computed data
4.	Chapter 7 Statistical Data Treatment and Evaluation - Confidence intervals, z test, t test - Analysis of variances - Detection of gross errors, Q test
5.	Chapter 8 Sampling, Standardization and Calibration - Analytical samples and methods - Sampling - Standardization and calibration
6.	- Sensitivity and detection limit - Linear dynamic range
7.	Chapter 9 Aqueous Solution and Chemical Equilibria - Chemical composition of aqueous solutions - Chemical Equilibrium
8.	- Buffer solutions Chapter 10 Effect of Electrolytes on Chemical Equilibria - Effect of electrolytes on chemical equilibria
9.	- Activity coefficients Chapter 14 Principles of Neutralization Titrations - Solutions and indicators for acid base titrations - Titrations of strong acids and bases
10.	- Titration curves for weak acids - Titration curves for weak bases - Composition of solutions during acid/base titrations
11.	Exam 1
12.	Chapter 15 Complex Acid- Base Systems - Mixtures of strong and weak acids or strong and weak bases - Polyfunctional acids and bases - Buffer solutions involving polyprotic acids
13.	- Calculations of the pH for solution of NaHA - Titration curves for Polyfunctional acids and bases

14.	Chapter 17 Complexation and Precipitation Reactions and Titrations - The formation of complexes - Complexation titrations - Complexes of EDTA and metal ions
15.	Chapter 18 Introduction to Electrochemistry - Characterizing Oxidation/reduction reactions - Electrochemical cells
16.	- Electrode potentials
17.	Chapter 19 Applications of Standard Hydrogen Electrodes - Constructing redox titration curves - Oxidation/Reduction indicators
18.	Chapter 20 Application of Oxidation/Reduction Titrations - Applying standard reducing agents - Applying standard oxidizing agents
19.	Chapter 21 Potentiometry - General Principles - Reference electrodes
20.	- Liquid-junction potentials - Indicator electrodes
21.	Exam 2
22.	Chapter 24 Introduction to Spectrochemical Methods - Properties of electromagnetic radiation - Interaction of radiation
23.	- Absorption of radiation - Emission of electromagnetic radiation
24.	Chapter 26 Molecular Absorption Spectrometry - Ultraviolet and visible absorption spectroscopy - Infrared absorption spectroscopy
25.	Chapter 31 Introduction to Analytical Separations - Separation by precipitation - Separation by distillation - Separation by Extraction
26.	- Separation by ion exchange - Chromatographic separation
27.	Chapter 32 Gas Chromatography - Instruments for gas –liquid chromatography - Gas chromatographic columns and stationary phases
28.	Chapter 33 High Performance Liquid Chromatography - Instrumentation - Partition Chromatography - Ion Chromatography - Affinity Chromatography - Chiral Chromatography
Final Exam	

COURSE LABORATORY OUTLINE

1. Check in, Weighing Technique and Proper Use of Buret and Pipet. Begin the Preparation of Solutions for Iodometric Analysis of Vitamin C for the Next Experiment.
2. Iodometric Analysis of Vitamin C (Chap. 13, Skoog et al.) and Calibration of a Pipet
3. EDTA Titration of Ca^{2+} and Mg^{2+} in Limestone (Chap. 17D-7, -9, Skoog et al.)
4. Determination of F^- Using an Ion Selective Electrode (Chap. 21D-5, Skoog et. Al.)
5. Potentiometric Titration of Fe^{2+} in Unknowns (Chap. 21, Skoog et al.)
6. Spectrophotometric Analysis of a Mixture: Caffeine and Benzoic Acid in an Unknown (Chap. 25, 26 Skoog et al.)
7. Microscale Spectrophotometric Measurement of Iron in Limestone by Standard Addition
8. Separation of Ni^{2+} from Co^{2+} using an Anion Exchange Column (Chap.31D, Skoog et al.)
9. Determination of the Composition of a Mixture of Organic Compounds using Gas Chromatography (Chap. 32, Skoog et al.)
10. Check Out

CHE-249 Quantitative Analysis 2018 Fall Semester Revised
Please Note: This schedule is subject to minor change so that course material can be best presented.

M	Exp.	Tu	Exp.	W	Exp.	Th	Exp.
28-Aug	1	29-Aug	1	30-Aug	1	31-Aug	1
4-Sep	No Class	5-Sep	2	6-Sep	2	7-Sep	2
11-Sep	2	12-Sep	2	13-Sep	2	14-Sep	3
18-Sep	3	19-Sep	*3	20-Sep	No Class	21-Sep	No Class
25-Sep	3	26-Sep	3	27-Sep	3	28-Sep	3
2-Oct	3	3-Oct	4	4-Oct	4	5-Oct	4
9-Oct	No Class	10-Oct	4	11-Oct	4	12-Oct	5
16-Oct	4	17-Oct	5	18-Oct	5	19-Oct	5
23-Oct	5	24-Oct	6	25-Oct	5	26-Oct	6
30-Oct	6	31-Oct	6	1-Nov	6	2-Nov	6
6-Nov	6	7-Nov	7	8-Nov	6	9-Nov	7
13-Nov	7	14-Nov	7	15-Nov	7	16-Nov	8
20-Nov	7	21-Nov	**	22-Nov	8	23-Nov	No Class
27-Nov	8	28-Nov	8	29-Nov	8	30-Nov	8
4-Dec	9	5-Dec	9	6-Dec	9	7-Dec	9
11-Dec	10	12-Dec	10				