SYLLABUS

A. Course Description

Course Code	*Course Num.*	*Course Name*	*Credit Hours*	*Lec.*	*Lab.*	*Tut.*	*Private study*	*Pre-requisites*	*Course Level*	*Language*
CHM	**231**	**Analytical Chemistry**	**4**	**2**	**3**	**1**	**6**	**CHM 102**	**4**	**English**

This course is an introduction to the theory, principles, and practices of quantitative analytical chemistry. The course covers the fundamentals of analytical chemistry: statistical data analysis, application of chemical equilibrium to gravimetric, titrimetry and electrochemistry.
At the end of this course the student will be able to:

- To recognize the main principles of analytical chemistry.
- To list some of the analytical chemistry methods.
- To state formula related to statistics.
- To outline types of concentration expressions.
- To describe the effect of different errors on the analytical results.

B. References: Required Textbook & Internal Website

I shall use ***Quantitative Chemical Analysis,*** Daniel C. Harris, 8th edition, 2010, W. H. Freeman & Co., New York, ISBN: 9781429218153.
Students are required to purchase the textbook/materials (it is an obligation). The book contains the lecture notes as well as activities for the students to take part in; the book serves as a workbook. Other references:

- ***Modern Analytical Chemistry***, David Harvey,1st Ed, 2000, McGraw-Hill, ISBN: 0–07–237547–7
- ***Chemical Analysis: Modern Instrumentation Methods and Techniques,*** Francis Rouessac, Annick Rouessac, 2nd Ed, 2007, John Wiley & Sons, ISBN: 0470859040, 9780470859049.
- ***Principles of Instrumental Analysis***", D. A. Skoog, F. J. Holler, S.R. Crouch,; 6th edition (2006) , Brooks Cole, ISBN: 0495012017 , 978-0495012016.

Website:

- **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true**
- **http://www.chem1.com/acad/webtext/virtualtextbook.html**
- **http://www.shodor.org/UNChem/index.html**

Google Classroom Webpage: http://www.imamm.org/

C. Topics Outline

Disclaimer: this is a very fast-paced course. There will be little time—if any—for review. What follows is an approximate outline of the pace of the course. We may go faster or slower, contingent on the class response. The tentative list of topics to cover:

1. **Review the basic calculations of analytical chemistry (chemical concentrations and stoichiometry relationship):** Relationship between Analytical Chemistry and other branches of science, General steps in chemical analysis, Measurements , Fundamental SI units , Derived SI units, other units, Conversion to SI units, Prefixes, Chemical concentrations , Molarity , Molality, Percentage composition , ppm and ppb, Preparing Solutions, Dilution, Stoichiometry Calculations.
2. **Statistics and data analysis in analytical chemistry:** Experimental Errors, Significant Figures, Significant Figures in arithmetic, Addition and Subtraction, Multiplication and Division. Graphs, logarithms and antilogarithms, Types of Errors, Systematic and Random Errors, Precision and Accuracy, Absolute and Relative Uncertainty, Propagation of Uncertainty from random errors
3. **Acid/Base Titrations:** Titration: methods of end point determination, , acid – base titrations, titration of strong acid with strong base, regions of equivalence point , before , at and after equivalence point, the titration curves, finding the end point with indicators, choosing an indicator. Precipitation Titrations: Precipitation titration curve, concentrations before, at and after the equivalence point, the shape of titration curves.
4. **Complexometric Titrations:** EDTA titrations, metal chelate complexes, acid-base properties of EDTA, EDTA complexes, EDTA titration curves, regions of equivalence point , before , at and after equivalence point, titration calculations, metal ion indicators, EDTA titrations techniques, direct, indirect , displacement and back titrations, water hardness, masking.
5. **Oxidation/Reduction Titrations:** Basic concepts of Redox reactions, galvanic cells, salt bridges, line notations, Nernst equation for half reaction, Nernst equation for complete reaction, Redox titrations. The shape of redox titration curves, regions of equivalence point , before , at and after equivalence point, finding the end point, Redox indicators,
6. **Fundamentals of chemical equilibria:** The equilibrium constant. Manipulations of equilibrium constant. Equilibrium and thermodynamics (enthalpy, entropy and free energy.), Le Chatelier's principle, solubility products. Common ion effect. Separation by precipitation. Complex formation protic acids and bases, Brønsted concept, salts, conjugate acids and bases. Autoprotysis, pH, strength of acids and bases. Weak acids and bases. Polyprotic acids and bases, relation between K_a and K_b. Solving equilibrium problems with concentration tables.
7. **Effect of Electrolytes on equilibrium systems:** The effect of ionic strength on the solubility of salts. meaning of ionic strength, Activity coefficient, PH and the activity coefficients. systematic treatment of equilibrium. charge and mass balance. applications to the systematic treatment of equilibrium. monoprotic acid base equilibrium. strong acids and bases equilibrium. weak acids and bases , equilibrium. weak acids equilibria + problems. weak bases equilibria and problems. buffers. Henderson – Hasselbalch Equation. buffer action. addition of acids and bases to buffers. how to prepare a buffer solution. poly protic acid base equilibrium, diprotic acids and bases equilibrium + calculations poly protic acid base equilibrium, triprotic systems identification of principle species in the equilibrium.

D. Exams & Grading System

The semi-official dates and the workload of students for this course are:

- **Midterm 1: 1 exam**
- **Midterm 2: 1 exam**
- **Quizzes : 2 quizzes**
- **Homeworks: 4 homeworks**
- **Final Exam:** 16th week.

	Teaching/learning activities	Contact Hours	Frequency	Total Contact hours	Self-study hours (hrs)	Total self-study hours	Student Learning Time
1	Lecture	2	15	30	2	30	60
2	Tutorial	1	15	15	1	15	30
3	Lab\Practical	3	14	42	0	0	42
4	Lab report	0	14	0	1	14	14
5	Lab Exam	3	1	3	3	3	6
6	Homework	0	4	0	2	8	8
7	Quiz	0.25	2	0.5	1	2	2.5
8	Test (Midterm)	1.5	2	3	8	8	11
9	Final Exam	2	1	2	9	9	11
Total				**95.5**		**89**	**184.5**

Independent self-study = 89/15 ≅ 6 hrs per week (as average**)**

Your course grade will be based on Final Exam, Midterms, Homework, Quizzes, Participation, Attendance and Project.

Midterm 1: 10 %	**Midterm 2:** 10 %	**Final Exam:** 40 %
Laboratory: 30 %	**Quizzes; Homework & Attendance & Participation:** 10 %	

Grading distribution:

A^+: [95, 100], A: [90, 95), B^+: [85, 90), B: [80, 85), C^+: [75, 80), C: [70, 75), D^+: [65, 70), D: [60, 65), F: [0, 60).

E. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. ("Immediate family" is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

Executive Rules for Study Regulations and Exams
goo.gl/ykm7t3

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