KINGDOM OF SAUDI ARABIA
Ministry of Education
Al-Imam Mohammad Ibn Saud Islamic University
College of Sciences
Department of Chemistry

المملكة العربية السعودية
وزارة الـتــعــلـيـــــم
جامعة الإمام محمد بن سعود الإسلامية
كلية العلوم
قسم الكيمياء

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**	**8**	**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 Ed.), W. H. Freeman & Co., New York, 2010, 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.), McGraw-Hill, 2000, ISBN: 0–07–237547–7
- *Chemical Analysis: Modern Instrumentation Methods and Techniques,* Francis Rouessac, Annick Rouessac, (2nd Ed), John Wiley & Sons, 2007, ISBN: 0470859040, 9780470859049.
- *Principles of Instrumental Analysis*", D. A. Skoog, F. J. Holler, S.R. Crouch, (6th Ed.), Brooks Cole, 2006, 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/

KINGDOM OF SAUDI ARABIA
Ministry of Education
Al-Imam Mohammad Ibn Saud Islamic University
College of Sciences
Department of Chemistry

المملكة العربية السعودية
وزارة الـتــعــلــيـــــم
جامعة الإمام محمد بن سعود الإسلامية
كلية العلوم
قسم الكيمياء

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:

a. Theory:

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.

KINGDOM OF SAUDI ARABIA
Ministry of Education
Al-Imam Mohammad Ibn Saud Islamic University
College of Sciences
Department of Chemistry

المملكة العربية السعودية
وزارة التــعــلــيـــم
جامعة الإمام محمد بن سعود الإسلامية
كلية العلوم
قسم الكيمياء

b. *Practical***:**

Safety in the Chemistry Laboratory & Laboratory Report writing, assuring the Quality of Weight Measurements (Calibration of the Analytical Balances). Statistical Evaluation of Measurements. Weight Uniformity of Dosing Units Statistical Evaluation of Measurements. Determination of the Acidic Content of Vinegar Calibration of PH-meter. PH Titration Curves of Weak Acid and bases). Preparation and Standardization of EDTA. Determination of Water Hardness. Standardization of Silver Nitrate Solution. Determination of Chloride Content in Table Salt and Tap Water by the Mohr Method. Standardization of Ferrous Ammonium Sulphate Using Standard Potassium Dichromate Solution. Determination of Iron Oxide Content in Portland cement. Sampling of Natural Samples, e.g., Soil of the garden, Rocks, Plant Leaves, etc. Sampling of Commercial Products, eg, Cement, Flour, and Toilet Soap. Determination of Moisture Content in Natural and Industrial Samples. Practice of Gravimetric Analysis Using Physical Separation Methods: Gravimetric Determination of Sulphate in a Commercial Unknown (gypsum). The Percent of Water of Crystallization in Hydrated Barium Chloride. Review.

D. Exams & Grading System

The semi-official dates of the exams for this course, with all the caveats, that the word "semi-official" entails, can be found here:

  – **Midterm 1:** 6th or 7th week &**Midterm 2:**11th or 12th week

  – **Quizzes& Homeworks: During the semester**

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).**

KINGDOM OF SAUDI ARABIA
Ministry of Education
Al-Imam Mohammad Ibn Saud Islamic University
College of Sciences
Department of Chemistry

المملكة العربية السعودية
وزارة الــتـــعـــلـــيــــم
جامعة الإمام محمد بن سعود الإسلامية
كلية العلوم
قسم الكيمياء

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 Examsgoo.gl/ykm7t3

Copy short URL