SYLLABUS

A. Course Description

Course Code	*Course Num.*	*Course Name*	*Credit Hours*	*Lec.*	*Lab.*	*Tut.*	*Private study*	*Pre-requisites*	*Course Level*	*Language*
CHM	**332**	**Instrumental Analysis CHM 332**	4	2	3	1	**8**	**CHM 231**	**5**	**English**

The topics taught in this course include: Electromagnetic spectrum and its properties, spectrometers, Ultra violet and visible, infrared and Raman, atomic absorption and atomic emission, molecular emission, NMR and X-rays.

At the end of this course the student will be able to:

- To recall the basic principles of instrumental analytical techniques.
- To recognize the role of instruments in solving problems in the physical, chemical and biological samples.
- To name the components of each instrument and their functions
- To define suitable methods of sampling and analysis.
- To tell the meaning of, and how, to estimate absorbance, transmittance and concentrations.

B. References: Required Textbook & Internal Website

I shall use ***Principles of Instrumental Analysis***, D. A. Skoog, F. J. Holler, S.R. Crouch, (6th Ed.), Brooks Cole, 2006, ISBN: 0495012017, 978-0495012016.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:

- ***Quantitative Chemical Analysis,*** Daniel C. Harris, (8th Ed.), W. H. Freeman & Co., New York, 2010, ISBN: 9781429218153.
- ***Undergraduate Instrumental Analysis,*** James W. Robinson, Eileen M. Skelly Frame, George M. Frame II, (6th Ed.), 2004, CRC Press.

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:

a. Theory:

1. **Introduction to Spectroscopy:** Electromagnetic spectrum, relationships between frequency, wavelength and E, components of an optical spectrometer
2. **Atomic Absorption Spectroscopy:** Energy levels, selection rules, instrumentation. Sample atomization, flame and graphite furnace. Fuel, oxidants and interferences.
3. **Atomic Emission Spectroscopy:** Emission of radiation, ground and excited states, flame photometer, instrument anatomy, Inductively Coupled Plasma (ICP), comparison with flame photometry.
4. **Molecular Absorption Spectroscopy:** Ultraviolet and visible spectroscopy, electronic levels and electronic transitions, instrumentation. Beer' -Lambert law, transmittance and absorbance, relation. Infrared spectroscopy Dipole moment, molecular stretching and bending vibrations, instrumentation. Raman spectroscopy and polarizability change.
5. **Molecular Emission Spectroscopy:** Molecular orbitals, absorption and emission, singlet and triplet states, fluorescence, phosphorescence
6. **Nuclear Magnetic Resonance:** Spin and magnetic quantum numbers. Relationship between nuclear spin and magnetic field H0. H-NMR, 13C-NMR.
7. **X-ray techniques:** X-ray fluorescence. Energy levels leading of X-ray emission. Auger electrons. Instrumentation, production of electrons and X-rays, XRF.
8. **Electrochemical Techniques:** Nernst equation, cyclic voltammeter, pH meter and other ion-selective electrodes, Polarography.

b. Practical:

Safety and Laboratory equipment's and measurements and reports, Introduction to UV-Vis spectrometer and its operation. Single and double beam. Verification of transmittance-absorbance relation, Standard addition method for determination of an unknown concentration using Beer's law for determination of an unknown concentration. Determination of the equilibrium constant for ferric thiocyanate complex using spectrophotometer, Titration of an acid and a base using pH meter, Titration of an acid and a base using conductivity meter, Determination of elemental content of a sample by ICP, Determination of an IR spectrum of some organic compounds, Determination of alkali metal concentrations using flame photometer (1), Determination of alkali metal concentrations using flame photometer (2), Cyclic voltammeteric study of potassium ferricynide /ferrocynide system. Determination of Cl-, H+, SO42-, and NO3- using ion selective electrodes.

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).

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

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