IRAN UNIVERSITY OF MEDICAL SCIENCES

School of pharmacy
Department of Medicinal Chemistry

Course title: Instrumental Analysis I (Theory, **M-Pharm**)
Credit: 3 credits, Sunurday (13-16)
***Prerequisite*:** Analytical Chemistry, Organic Chemistry
Responsible Instructor: Dr. Mirfazli

Course Description:

- Course objectives:

This course examines methods for the separation, identification and quantification of substances in the solid, liquid and vapour states. Emphasis will be placed on modern instrumental methods and trace analysis. Satisfactory completion of this course will afford students a working knowledge of analytical instrumentation typically employed in chemical and biochemical research laboratories. It will also provide the student with an appreciation of the relative strengths and limitations of different instrumental based analysis methods.

- Course content:

Introduction: Goals of the course. The process of chemical analysis. Instrumental analytical methods versus classical analytical methods. Selectivity and interferences in trace analysis. Figures of merit in instrumental analysis (Accuracy, Precision, Sensitivity, Dynamic Range, Detection Limits, Selectivity).
Spectroscopic Methods: Atomic Absorption Spectroscopy, Infra-Red Spectrometry, Mass spectrometry.
Separation Methods: The principles of chromatography, Gas Chromatography, Liquid Chromatography,
Electroanalytical Methods: Polarimetry, Conductometry.

- Specific Course Learning Objectives Include:

1- Demonstrate knowledge of sampling methods for all states of matter.
2- Assess sources of error in chemical and instrumental analysis and account for errors in data analysis.
3- Recognize interferences in chemical and instrumental analysis.
4- Comprehend the concept of and perform instrument and method calibration.
5- Integrate a fundamental understanding of the underlining physics principles as they relate to specific instrumentation used for atomic, molecular, and mass spectrometry, magnetic resonance spectrometry and chromatography.
6- Understand and be able to apply the theory and operational principles of analytical instruments.
7- Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for elemental and molecular analysis.

Course Evaluation:

Instructor	Total mark
Dr. Mirfazli	**6.5**
Dr. Azizian	**6.5**
Dr. Daneshmehr	**2.8**
Dr. Asadi	**4.2**

Important Note:

Midterm will be held in class as scheduled in course time table.

Final Exam will be held as determined by the registrar's office.

In Class Discussions:

Participation in classroom discussions and interacting with your class colleagues is an important aspect to successful learning. If you really want to learn and succeed in this class, you will want to participate in the questions posed by your lecturer during the class and to ask your own questions.

It is needed to have you honestly participate in the class. To this end, we will provide 10% of your grade to be calculated as follows. There will be many days throughout the semester in which class discussions will be conducted. If you make a contribution to the class discussion on a given day, then it will be taken that you have participated that day. If you participate in at least 85% of the days on which class discussion are conducted you will receive 10 marks towards your final grade. If you participate for at least 60% of the days, you will get 5 marks; at least 40 will earn you 3 marks. It is known that students will do better on their exams if they participate in learning activities and class discussions and it is felt that it is important to offer this to those who are willing to make the effort.

To be best prepared to participate you should read the appropriate sections of the textbook and be prepared to discuss them.

Semester Project(s):

More information will be determined during class discussions.

Missed Midterm:

A grade of zero will be assigned for a missed midterm except for valid medical or compassionate reasons.

Instrumental Analysis I -2023 Course Table

Sunday 13-16

	Subject	Instructor	Learning activities/ assignment	Date
1	Introduction to Instrumental Analysis	Dr Mirfazli	The process of chemical analysis. Instrumental analytical methods versus classical analytical methods. **Expectations:** Participation in class discussions and asking own questions.	**19 Feb. 30/11/01**
2	Chromatography principals, HPLC	Dr Mirfazli	What Is Chromatography? Efficiency of Separation, Injection and Detection in HPLC, HPLC instrument. **Expectations:** Participation in class discussions and asking own questions.	**26 Feb. 7/12/01**
3	HPLC	Dr Mirfazli	Method Development for Reversed-Phase and Normal-Phased Separation, Columns, Isocratic and Gradient Separations in HPLC. **Expectations:** Participation in class discussions and asking own questions. Work on assignments.	**5 Mar. 14/12/01**
4	HPLC	Dr Mirfazli	Van-Deemter equation and parameter in HPLC. Chromatographic Methods. **Expectations:** Participation in class discussions and asking own questions. Work on assignments.	**12 Mar. 21/12/01**
5	HPLC -GC	Dr Mirfazli Dr. Azizian	Detectors in HPLC. GC instrument, Separation mechanism, Columns. **Expectations:** Participation in class discussions and asking own questions. Work on assignments	**19 Mar. 28/12/01**
6	GC	Dr. Azizian	The Separation Process in Gas Chromatography, Injectors in GC. Separation mechanism, Columns, Detectors in GC. **Expectations:** Participation in class discussions and asking own questions. Work on assignments.	**9 Apr.**
7	NMR	Dr. Azizian	Nuclear transitions, Instrumentation, Quantization of ^{1}H Nuclei in a Magnetic Field. **Expectations:** Participation in class discussions and asking own questions. Work on assignments.	**16 Apr.**
8	NMR- Mass	Dr. Azizian	Chemical Shifts, SPIN–SPIN Coupling. Interpretation of Proton Spectra. Introduction to mass spectrometry (type of ions, isotopes, mass spectra). **Expectations:** Participation in class discussions and asking own questions. Work on assignments and solve related problems.	**30 Apr.**
	Session 1-4		**Midterm Exam (12-14)**	30 Apr.
9	Mass	Dr. Azizian	Ionization methods in atomic and molecular mass spectrometry. **Expectations:** Participation in class discussions and asking own questions. Solve related problems	**7 May**
10	UV	Dr. Asadi	Electronic transitions, Applications of UV-Vis spectroscopy. UV-Vis Instrument. **Expectations:** Participation in class discussions and asking own questions. Work on assignments.	**14 May**

11	UV	Dr. Asadi	Absorbing Species, Qualitative and Quantitative applications of UV-Vis Spectroscopy. **Expectations:** Participation in class discussions and asking own questions. Work on assignments.	**21 May**
12	IR	Dr. Daneshmehr	Absorption of IR Radiation by Molecules, Types of Vibrations in Molecules. Qualitative Analyses and Structural Determination of Hydrocarbons. **Expectations:** Participation in class discussions and asking own questions. Solve related problems.	**28 May**
13	IR	Dr. Daneshmehr	Qualitative Analyses and Structural Determination of Organic Compounds with C–O Bonds, Nitrogen-Containing Organic Compounds, Functional Groups Containing Heteroatoms **Expectations:** Participation in class discussions and asking own questions. Solve related problems.	**11 Jun.**
14	Refractometry and Polarimetry	Dr. Asadi	Refractometer and Polarimeter applications, Samples and measurement values, Instrumentation. **Expectations:** Participation in class discussions and asking own questions.	**18 Jun.**

References:

1- Principal of Instrumental Analysis, Douglas A. Skoog, 7th edition, 2007.

2- Introduction to spectroscopy, Donald L. Pavia, 5th edition, 2015.

3- Undergraduate instrumental analysis, 7th edition, 2014

Strongly Recommended: Reading the textbook is an essential component of the class. Students should read ahead and be prepared to ask/answer questions during class on the material as it is covered.