Philadelphia University
Faculty of Pharmacy
Department of Pharmaceutical Sciences
Second semester, 2017/2018

Course Syllabus	
Course title: Instrumental Chemical Analysis	**Course code:** 0510212
Course level: Second year	**Course prerequisite:** 0510113
Lecture time: Sunday/Tuesday : 1:10-2:00	**Credit hours:** 2 hours **Contact hours:** 2 hours
Location: 9311	

Academic Staff				
Name	**Rank**	**Office number and location**	**Office hours**	**E-mail address**
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Course description

This course is devoted to the exploration of the instrumental methods of analysis used in various pharmaceutical analysis; Spectroscopic methods (UV-Visible, IR, NMR), Chromatographic methods (HPLC and GC), Mass spectrometry and Electroanalytical methods.

Course objectives

- Describe the principles of different types of instrumental methods used in pharmaceuticals analysis including spectroscopy, electrochemistry and separation techniques.
- Provide the basic tools and facilitate the practical applications of quality control in the production of pharmaceuticals and how pharmaceutical analysis is used to determine the quality of ingredients and the final product.
- Define components and operation procedures, interpret results acquired, and assess the benefits and limitations of different instrumental methods that are critical to drug design and development.
- Identify appropriate instrumental methods that fit certain chemical analysis of a certain pharmaceutical product.
- Design experiment, implement analysis using the relevant chemical literature, process and analyze the data and, effectively, communicate results orally and in writing

Course components

- **Books (title, author (s), publisher, year of publication)**
  - Textbook: Chemical Analysis: Modern Instrumentation Methods and Techniques; F. Rouessac and A. Rouessac, John Wiley; 2nd edition (2007).
  - Supplementary Textbook: Undergraduate Instrumental Analysis", J., W. Robinson, Marcel Dekker, 6th edition; (1995).
- **Support material (s) (vcs, acs, etc). N/A**

- **Homework and laboratory guide (s) if (applicable).**
  Handouts containing problems to solve related to each topic will be provided to the students.

Teaching methods

Lectures and problem solving sessions are the main teaching methods in this course. In class lecturing where current topics are interrelated to the past and future topics. Basic principles, instrumental design and application of each technique are discussed with students. Numerical problems and identification of some pharmaceutical compounds related to each topic will be discussed in the class.

Learning outcomes

Knowledge and understanding

Upon completion of this course students will be able to:

- Describe the basic principles, the instrumental design and advantages and limitations of a variety of analytical techniques, including: electrochemical, spectrochemical (molecular and atomic), and chromatographical methods of analysis critically used in pharmaceutical analysis.
- Distinguish the qualitative and quantitative methods for the analysis of raw materials, and pharmaceutical finished products.
- Demonstrate the knowledge of data acquisition and analysis for various techniques.
- Interpret the Uv-visible, infrared, mass and NMR spectra for structure identification of some pharmaceutical compounds.
- Implement suitable methods of sampling and analysis.
- Explain the meaning of, and how, to estimate the bias, precision, accuracy and detection limit of an analytical method.
- Interpret the relevant chemical literature.

Cognitive skills (thinking and analysis)

- Compare various instrumental methods used in pharmaceutical analysis and assess their advantages and disadvantages.
- Demonstrate capability of choosing the appropriate instrumental method for a particular investigation pertinent to a certain drug or pharmaceutical product.
- Demonstrate the differences between various types of instruments in terms of parts and functions
- Evaluate raw materials and pharmaceutical products using suitable quantitative and qualitative techniques.
- Identify the unknown organic compounds by interpretation of combined spectra.
- Formulate significant research questions, design experiments, use appropriate chemical instrumentation, and analyze and interpret data.
- Search and use the chemical literature in both printed and electronic formats.
- Work on different instruments critical for pharmaceutical analysis.
- Apply critical thinking and hypothesis-driven methods of scientific inquiry.

- ***Practical and subject specific skills (Transferable Skills)***
  - Use pharmaceutical analysis techniques to identify simple organic and pharmaceutical molecules.
  - Use Good Manufacturing Process (GMP) guidelines to develop processes, procedures, training and documentation to produce pharmaceuticals of appropriate quality and quality assures them.
  - Formulate significant research questions, design experiments, and use appropriate chemical instrumentation whenever needed in a quality control laboratory.
  - Read, evaluate, and interpret numerical, chemical and general scientific information.
  - Acquire a working knowledge of basic research methodologies, data analysis and interpretation of data relevant to pharmaceutical analysis.
  - Demonstrate effective written and oral communication skills, especially the ability to transmit complex technical information in a clear and concise manner.
  - Demonstrate ability to search and use the chemical literature in both printed and electronic formats.

Assessment instruments

- In-class quizzes
- Two major exams and the final exam

Allocation of Marks	
Assessment Instruments	**Mark**
First examination	**20**
Second examination	**20**
Final examination:	**40**
Quizzes & Home works	**20**
Total	**100**

Course academic calendar

# classes	Chapter #: main topics	Basic and support material to be covered
1	**Introduction**	Instrumental analytical methods, Analysis steps, instrumental methods characteristics and criteria.
4	**Chromatography** (Chapter 1: General aspects of chromatography)	Basic principles, chromatogram, applications, column efficiency, band broadening, van Deemter equation, parameters used in evaluating column performance, chromatography types.
1.5	(Chapter 2: Gas chromatography)	Characteristics and instrumentation.
1.5	(Chapter 3: High-performance liquid chromatography)	Characteristics and instrumentation.
6	**Ultraviolet and visible spectroscopy** (Chapter 9: Ultraviolet and visible absorption spectroscopy)	Basic principles of molecular spectroscopy, Beer-Lambert law, spectra of some representative drug molecules. Applications to pharmaceutical quantitative analysis
1	**First Major Examination**	
4	**Infrared spectroscopy** (Chapter 10: Infrared spectroscopy)	Basic principles of IR spectroscopy, instrumentation. application of IR in structure elucidation, near IR analysis and its pharmaceutical applications
5	**Nuclear magnetic resonance spectroscopy** (Chapter 15: Nuclear magnetic resonance spectroscopy)	Basic principles of NMR technique and instrumentation, proton-NMR and carbon-13 NMR. Applications of NMR to structure confirmation in some drug molecules
4	**Mass spectrometry** (Chapter 16: Mass spectrometry)	Basic principles of mass spectrometry and instrumentation, mass spectra, molecular fragmentation, Applications in pharmaceutical applications and characterization of degradation products
1	**Second Major Examination**	
3	**Electroanalytical methods of analysis** (Capter 19: Potentiometric methods)	Various types of electrodes ad ion-selective electrodes, Potentiomety and potentiometric titration, Karl Fischer titration, Applications in pharmaceutical analysis.
	Final Examination	

Documentation and academic honesty

- ***Documentation style (with illustrative examples)***
  Whenever applicable, students should conduct their assignments themselves whether individually or in a group work referencing all information, data, figures and diagrams taken from literature. The references should be given according to the acceptable format.

- ***Protection by copyright***
  Students should realize that some published information or data are the property of their authors and they are not allowed to use it without asking permission from the originators.

- ***Avoiding plagiarism.***
  Plagiarism is the unauthorized use or close imitation of the language and thoughts of another author and the representation of them as one's own original work, without proper acknowledgment of the author or the source. Students must pursue their studies honestly and ethically in accordance with the academic regulations. Cheating in exams and plagiarism are totally unacceptable and those who, intentionally, commit such acts would be subjected for penalties according to the University regulations.

Expected workload

On average, students need to spend 2 hours of study and preparation for each 50-minute lecture/tutorial.

Attendance policy

Absence from lectures shall not exceed 5. Students who exceed the 5 classes limit without excuse acceptable to and approved by the Dean shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

References

A. Books

- Pharmaceutical Analysis, David Lee and Michael Webb, Blackwell Publishing, 2003.
- Principles of Instrumental analysis, Douglas A. Skoog, F. James Holler, and Stanley R. Crouch; Brooks Cole; 6th edition, 2006.
- Modern Instrumental Analysis, , Neil D. Jespersen and Satinder Ahuja, Elsevier, 2006.
- Method validation in pharmaceutical analysis: A guide to best practice, J. Ermer and J. Miller (Editors), John Wiley 2005.
- Handbook of modern pharmaceutical analysis, S. Ahuja and S. Scypinski (Editors), Academic Press, Second edition, 2011.
- D. Harvey, "Modern Analytical Chemistry", McGraw Hell, 2000.

B. Websites

Some websites are mentioned in the textbook at the end of each chapter. Other sites will be given during the classes and may be given as assignments to the students.