Department	Pharmacy

Course Name	Instrumental Analysis	Course No.	201217
Prerequisite	Pharmaceutical Analytical Chemistry	Credit Hours	3
Number & date of course plan approval	2016-2017	Brief Description	See form QF02/0409

Course Objectives	This course aims to cover different instrumental techniques used in pharmaceutical analysis.
Intended Learning Outcomes	1-At the end of this course the student is expected to have acquired basic knowledge regarding the importance of analysis in pharmaceutical industry and the principles for different instrumental methods of analysis including electrochemical (potentiometry and conductimetry), spectroscopic (UV/ Vis., fluorometry, atomic spectroscopy, IR and NMR), chromatographic methods (HPLC and GC) and electrophoretic methods (HPCE). 2- The aims of this course include the ability of the student to employ the knowledge he would acquire through the course to design, develop and criticize analytical methods that are based on the principles taught in the course.
Course Topics	1- Electrochemistry: a. Potontiometry. b. Conductometry. 2- Polarimetry. 3- Refractometry. 4- Spectroscopic techniques: a. UV-vis spectroscopy. b. Molecular emission: i. Fluorescence. ii. Phosphorescence. c. Atomic spectroscopy: i. Flame photometry. ii. Atomic Absorption spectroscopy. d. Infrared spectroscopy. e. NMR: i. ^{1}H-NMR. ii. ^{13}C-NMR. f. Mass spectroscopy. 5- Chromatography: a. Paper Chromatography. b. Thin layer Chromatography. c. Ion exchange chromatography. d. Affinity Chromatography. e. Size exclusion chromatography. f. HPLC. g. Gas Chromatography (GC) 6- Capillary Electrophoresis (CE).

Text Books	1-Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, 3rd edition, David Watson, Elsevier/ Churchill Livingstone, 2012.
References	1- Spectroscopic Methods in Organic Chemistry, 6th edition, Dudley Williams, Ian Fleming, McGraw-Hill book company, 1995 2- Organic Structures from Spectra, 3rd edition, L. D. Field, S. Sternhell and J. R. Kalman, John Wiley & Sons, 2002. 3- Spectrometric Identification of Organic Compounds, 7th edition, Robert M. Silverstein, Francis X. Webster and David Kiemle, John Wiley & Sons, 2005. 4- Principles of Instrumental Analysis, 6th edition, Skoog, D. A., Brooks/ Cole Thomson Learning, 2007.
Grade Determination	1st Exam = 25% 2nd Exam = 25% Final Exam = 50%

Course Outline

Week	Hours	Subjects	Chapters in Textbook	Notes
1	1 1 1	- **Introduction:** • Review of the concept of pharmaceutical analysis in pharmaceutical industry and pharmacopoeal specifications of a pharmaceutical product. • Analytical methods review. • Importance of instrumental analysis. • Criteria of reliable analytical methods. • Basics of instruments in instrumental analysis. • Types of Error in experimental data. - **Potentiometry:** • Basic concepts of electrochemistry i.e. how potential difference is developed across a membrane. • Electrochemical cell and cell potential.	1 1 3	
2	1 1	- **Potentiometry:** • Types of electrodes, ion selective electrodes, membrane electrodes, silver electrode, calomel electrode, glass electrode. • pH measurement. • Applications of electrochemistry e.g. potentiometric titration of acids and bases. - **Conductometry:**	3	

	1	• Other methods involving electrochemistry • Conductimetry Applications of electrochemistry e.g. Conductimetric titration of acids and bases. - **Polarimetry:** • Basic concepts of polarimetry. • Polarometer.	3 2	
3	1 1 1	- **Refractometry:** • Basic concepts of refractometry. • Refractometer. - **UV-VIS spectroscopy:** • Basic concepts of light (spectrum and electromagnetic radiation) and interaction with matter, theory of excitation and structural requirements for light absorption. • Basic design of UV/ Vis. spectroscopy. • Beer's Lambert law.	2 4 4	
4	1 1 1	**- UV-VIS spectroscopy:** • Quantitative applications of Beer's Lambert law and its use in analysis. • Important considerations in using UV/ Vis. spectroscopy e.g. potential deviations from linearity and how to diagnose and resolve the problem. • - Effect of solvents and pH on spectra.	4 4 4	
5	1 1 1	**- UV-VIS spectroscopy:** • Potential effects of different instrumental factors like stray light and chemical factors like the nature of the sample being measured. • Quantitative and qualitative uses of UV/ Vis. e.g. determination of drugs in a mixture. • Mixtures assays.	4 4 4	
6	1 1 1	- **Luminescence Molecular Spectroscopy:** • Fluorescence and phosphorescence origin, excited and ground state. • Effect of structure, temperature and solvent. • Basic design of a spectrofluorometer and applications. ❖ **First exam.**	7 7 7	
7	1	- **Atomic Emission and Atomic Absorption**		

	1 1	**Spectroscopy:** • Basic theory of atomic excitation. • Analytical applications. • Instrumentation, advantages and disadvantages of each technique.	6 6 6	
8	1 1 1	- **Infra-Red Spectroscopy (IR):** • Origin of IR band, modes of vibrations. • Uses of IR for identification and elucidation of compounds. • Basic designs of the instrument • Practical handling of the sample.	5 5 5 5	
9	1 1 1	- **NMR Spectroscopy:** • The origin of resonance, spin- spin coupling. • The concept of chemical shift. • ^{1}H NMR.	8 8 8	
10	1 1 1	- **NMR Spectroscopy:** • ^{13}C NMR • Two dimensional NMR spectra. • Applications and examples. ❖ **Second exam**	8 8 8	
11	1 1 1	- **Mass Spectroscopy:** • Mass spectrometer, mass spectrum, • Fragmentation. • Application examples.	9 9 9	
12	1 1 1	- **Combined structure problems:** • UV spec. • IR spec. • Mass spec. • ^{1}H and ^{13}C NMR	Structural Elucidation	
13	1 1 1	- **Chromatographic Techniques:** • Theory of chromatography**.** • Basic concept of chromatogram. • Parameters of chromatography. e.g. retention time, peak width, resolution etc	10 10 10	
14	1	- **Chromatographic Techniques:**		

	1 1	• Instrumentation of HPLC, modes of HPLC: normal phase and reversed phase. Basic concept of chromatogram. • Factors affecting retention on either mode**.** • Gas chromatography.	12 12 11	
15	1 1 1	- **Chromatographic Techniques:** • Analytical applications of HPLC and GC. - **Capillary electrophoresis:** • **Theory of electrophoresis.** • **CE instrumentation, EOF and migration times.** • **Electropherogram.**	11 14 14	

Approved by Dept. Chair		Date of Approval	

Extra Information: (Updated every semester and filled by course instructor)

Course Instructor	
Office No.	
Extension **Email**	
Office hours	