Detailed Course Description - Course Plan Development and Updating Procedures/ Pharmacy Department	QF02/0408-3.0E

Faculty	Pharmacy	Department	Pharmacy
Course number	201217	Course title	Instrumental Analysis
Number of credit hours	3	Pre-requisite/co-requisite	Pharmaceutical Analytical Chemistry

Brief course description:
This course describe most important instrumental techniques used in pharmaceutical analysis. It includes most commonly used spectroscopic techniques such as UV-Vis, MES, AAS, AES, IR, NMR and Mass spectroscopies. In addition to separation techniques like chromatography and capillary electrophoresis. And electrochemical techniques.

	Course goals and learning outcomes
Goal 1	**Identifying the importance of analysis in pharmaceutical research and industry and the principles of important instrumental methods of analysis.**
Learning outcomes	1.1 At the end of this course the student should acquire the basic knowledge regarding the **importance** of analysis in pharmaceutical industry and the principles for different instrumental methods of analysis including: 1.1.1 Electrochemical (potentiometry and conductimetry). 1.1.2 Spectroscopic (UV/ Vis., fluorometry, atomic spectroscopy, IR and NMR). 1.1.3 Separation techniques including: chromatographic methods (HPLC and GC) and electrophoretic methods (HPCE).
Goal 2	**Designing, developing and criticizing pharmaceutical analytical methods, used in pharmaceutical industries and drug discovery.**
Learning outcomes	2.1 Students should gain the ability to employ the knowledge he/she has acquired through the course to **design**, **develop** and **criticize** pharmaceutical analytical methods based on their principles.
Goal 3	**Recognizing the applications of pharmaceutical analytical instrumentations in pharmaceutical fields.**
Learning outcomes	3.1 Students should obtain the ability to utilize his/her understanding to choose the best suited pharmaceutical technique for the required application in pharmaceutical research centers, manufacturers, industries and regulatory bodies.
Textbook	1. Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, 3rd edition, David Watson, Elsevier/ Churchill Livingstone, 2012.
Supplementary 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.

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Course timeline				
Week	**Number of hours**	**Course topics**	**Pages (textbook)**	**Notes**
1.	1 1 1	- **Introduction:** ﻻ Review of the concept of pharmaceutical analysis in pharmaceutical industry and pharmacopoeial specifications of a pharmaceutical product. ﻻ Analytical methods review. ﻻ Importance of instrumental analysis. ﻻ Criteria of reliable analytical methods. ﻻ Basics of instruments in instrumental analysis. ﻻ Types of Error in experimental data. - **Potentiometry:** ﻻ Basic concepts of electrochemistry i.e. how potential difference is developed across a membrane. ﻻ Electrochemical cell and cell potential.	1 1 3	
2.	1 1 1	- **Potentiometry:** ﻻ Types of electrodes, ion selective electrodes, membrane electrodes, silver electrode, calomel electrode, glass electrode. ﻻ pH measurement. ﻻ Applications of electrochemistry e.g. potentiometric titration of acids and bases. - **Conductometry:** ﻻ Other methods involving electrochemistry ﻻ Conductimetry Applications of electrochemistry e.g. Conductimetric titration of acids and bases. - **Polarimetry:** ﻻ Basic concepts of polarimetry. ﻻ Polarometer.	3 3 2	
3.	1 1 1	- **Refractometry:** ﻻ Basic concepts of refractometry. ﻻ Refractometer. - **UV-VIS spectroscopy:** ﻻ Basic concepts of light (spectrum and electromagnetic radiation) and interaction with matter, theory of excitation and structural requirements for light absorption. ﻻ Basic design of UV/ Vis. Spectroscopy.	2 4 4	

		⁃ Beer's Lambert law.		
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 1 1	**- Atomic Emission and Atomic Absorption 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.	8 8 8	

		⁾ ^{1}H NMR.		
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	Structure 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 1 1	- **Chromatographic Techniques:** ⁾ 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. ⁾ Analytical applications of GC. ⁾ Analytical applications of recent advances in chromatography.	11 11 11	
16.	1	- **Capillary electrophoresis:** ⁾ Theory of electrophoresis.	14 14	

	1 1	) CE instrumentation, EOF and migration times.) Electropherogram.		

Theoretical course evaluation methods and weight	Participation = 10% First exam 20% Second exam 20% Final exam 50%	**Practical (clinical) course evaluation methods**	Semester students' work = 50% (Reports, research, quizzes, etc.) Final exam = 50%

Approved by head of department		**Date of approval**	

Extra information (to be updated every semester by corresponding faculty member)

Name of teacher	**Dr. Ala A. Alhusban**	Office Number	**406**
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Office hours	Announced at office door.		