Course Plan for Master Program - Study Plan Development and Updating Procedures/ Pharmacy Department	QF02/0408-4.0E

Study Plan No.	**2021/2022**		**University Specialization**		**Master of Pharmaceutical Sciences**	
Course No.	**0201741**		**Course Name**		**Advanced Pharmaceutical Analysis**	
Credit Hours	**2 Theory & 1 Practical = 3 Hours**		**Prerequisite *Co-requisite**		**-**	
Course Type	☐ Mandatory University Requirement	☐ University Elective Requirement	☐ Faculty Mandatory Requirement	☐ Support course family requirements	☑ **Mandatory Requirement**	☐ Elective Requirement
Teaching Style	☐ Full Online Learning		☐ Blended Learning		☑ **Traditional Learning**	
Teaching Model	☐ 1 Synchronous: 1 Asynchronous		☐ 1 Face to Face: 1 Asynchronous		☑ **1 Traditional**	

Faculty Member and Study Divisions Information *(to be filled in each semester by the subject instructor)*

Name	Academic rank	Office No.	Phone No.	E-mail	
Office Hours (Days/Time)	**Sunday, Tuesday, Thursday ()**		**Monday, Wednesday ()**		
Division number	**Time**	**Place**	**Number of Students**	**Teaching Style**	**Approved Model**
				Traditional Learning	**1 Traditional**

Brief Description

This course is designed to provide students with required knowledge about the most important techniques used in pharmaceutical analysis. It describes the principles and applications of the most commonly used spectroscopic techniques such as UV-Vis, MES, AAS, AES, IR, NMR and Mass spectroscopies. In addition to separation techniques such as chromatography and capillary electrophoresis.

Learning Resources

Course Book Information (Title, author, date of issue, publisher ... etc)	Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, 5th edition, David Watson, Elsevier/ Churchill Livingstone, 2020. (Available at Al-Zaytoonah University of Jordan library)			
Supportive Learning Resources (Books, databases, periodicals, software, applications, others)	1. Principles of instrumental analysis, 7th edition, Douglas Skoog, James Holler, and Stanley Crouch, Cengage learning, 2018. 2. Spectrometric Identification of Organic Compounds, 8th edition, Robert Silverstein, Francis Webster, David Kiemle, and David Bryce, Wiley, 2014. 3. Fundamentals of Analytical Chemistry, 9th edition, Donald West, F. James Holler, Douglas A. Skoog & Stanley R. Crouch. Brooks/Cole – Thomson Learning, 2014.			
Supporting Websites				
The Physical Environment for Teaching	☑ **Classroom**	☐ Labs	☑ **Virtual Educational Platform**	☐ Others

Necessary Equipment and Software	Moodle
Supporting People with Special Needs	
For Technical Support	E-Learning & Open Educational Resources Center. Email: elearning@zuj.edu.jo; Phone: +962 6 429 1511 ext. 425/362.

Course learning outcomes *(K= Knowledge, S= Skills, C= Competencies)*

No.	Course Learning Outcomes	The Associated Program Learning Output Code
Knowledge **The student should be able to:**		
K1	Distinguish classifications of analytical methods used in pharmaceutical analysis and pharmaceutical research.	**MK1**
K2	Recognize the theories, principles, instrumentations, and applications of spectroscopy (UV-Vis, fluorescence, atomic, IR, mass and NMR) employed in pharmaceutical analysis and research.	**MK1**
K3	Outline classes and applications of separation techniques (HPLC, GC, and CE) utilized in pharmaceutical analysis and research.	**MK1**
Skills **The student should be able to:**		
S1	Explain the analytical approaches and methodologies employed in research articles addressed by pharmaceutical analysis.	**MS1**
S2	Perform qualitative and quantitative analysis by interpretation of UV, fluorescence, IR, NMR, and Mass spectra.	**MS2**
S3	Select the appropriate method of analysis to carry out the required practical work to support thesis or research projects.	**MS2**
S4	Determine the proper separation technique for analysis of various samples, matrices and dosage forms to conduct research projects.	**MS4**
Competencies **The student should be able to:**		
C1	Undertake accountability for continuous professional development.	**MC1**
C2	Stay up-to-date with the recent advances in pharmaceutical analysis and pharmaceutical research.	**MC2**

Mechanisms for Direct Evaluation of Learning Outcomes

Type of Assessment / Learning Style	Fully Electronic Learning	Blended Learning	Traditional Learning (Theory Learning)	Traditional Learning (Practical Learning)
Midterm Exam	30%	30%	**30%**	30%
Participation / Practical Applications	0	0	**Lab. Practical 20%** **Homework 10%**	30%

Asynchronous Interactive Activities	30%	30%	**0**	0
Final Exam	40%	40%	**40%**	40%

Note 1: *Asynchronous interactive activities are activities, tasks, projects, assignments, research, studies, projects, work within student groups ... etc, which the student carries out on his own, through the virtual platform without a direct encounter with the subject teacher.*

Note 2: *According to the Regulations of granting Master's degree at Al-Zaytoonah University of Jordan, 40% of final evaluation goes for the final exam, and 60% for the semester work (examinations, reports, research or any scientific activity assigned to the student).*

Schedule of Simultaneous / Face-to-Face Encounters and their Topics

Week	Subject	Learning Style*	Reference **
1	**Introduction**	Lecture	
2	**Control of the quality of analytical methods**: - Control of errors in analysis. - Accuracy and precision. - Validation of analytical procedures. - Standard operating procedure (SOP). - Terms used in the control of analytical procedures. **UV-Vis Spectroscopy:** - Principles, applications, strengths and limitations. - Factors governing absorption of radiation in the UV/visible region. - Beer–Lambert Law. - Instrumentation. - UV spectra of some representative drug molecules.	Lecture	Textbook: Ch. 1, pp. (1-24) Textbook: Ch. 4, pp. (89-111)
3	**Molecular Emission Spectroscopy:** - Principles, applications & limitations. - Behavior of an excited electron in a fluorescent molecule. - Instrumentation. - Molecules which exhibit fluorescence - Factors interfering with fluorescence intensity. - Applications of fluorescence spectroscopy in pharmaceutical analysis. **Atomic Emission Spectroscopy (AES):** - Principles, applications, strengths and limitations.	Lecture	Textbook: Ch. 7, pp. (151-161) Textbook: Ch. 6, pp. (137-141)

	- Behavior of an excited electron in atoms. - Instrumentation. - Interferences in AES analysis. **Atomic Absorption Spectroscopy (AAS):** - Principles, applications, strengths and limitations. - Basic theory of atomic excitation. - Instrumentation.		Textbook: Ch. 6, pp. (142-149)
4	- **Assay of UV/visible spectroscopy to pharmaceutical quantitative analysis.** - **Assay of fluorescence spectroscopy to pharmaceutical quantitative analysis.** - **Atomic Absorption Spectroscopy (AAS) demonstration and sample preparation.**	Practical	Research lab
5	**Chromatographic Theory**: - Introduction to chromatographic separations. - Classification of chromatographic methods. - Elution chromatography. - Chromatogram. - Distribution constants. - Retention time, column efficiency, retention factor, selectivity factor. - Van Deemter equation. - Column resolution, peak asymmetry. **Gas Chromatography (GC):** - Principles, applications, strengths and limitations. - GC Instrumentation. - GC type of columns. - Selectivity of liquid stationary phases. - Use of derivatization in GC. - GC detectors.	Lecture	Textbook: Ch. 10, pp. (247-259) Textbook: Ch. 11, pp. (260-293)
6	**High-performance liquid chromatography (HPLC):** - Principles, applications, strengths and limitations. - HPLC Instrumentation. - Stationary phases and Mobile phases.	Lecture	Textbook: Ch. 12, pp. (295-348)

	- HPLC elution of neutral compounds. - HPLC elution rate of ionizable compounds by adjustment of pH of mobile phase. - HPLC solvent selectivity. - HPLC effect of temperature. - HPLC vs UPLC. **High-performance capillary electrophoresis (CE):** - Principles, applications, strengths and limitations. - CE Instrumentation. - Electroosmotic Flow (EOF). - Electropherograms. - Variables controlling electrophoretic separation. - Applications of CE in pharmaceutical analysis. - Micellar electrokinetic chromatography (MEKC).		Textbook: Ch. 14, pp. (366-385)
7	- **HPLC demonstration and Assay.** - **CE demonstration and Assay.**	Practical	Research lab
8	**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.	Lecture	Textbook: Ch. 5, pp. (114-135)
9	**Midterm Exam**		
10	**NMR Spectroscopy:** - The origin of resonance, spin- spin coupling. - The concept of chemical shift. - ^{1}H NMR. **NMR Spectroscopy:** - ^{13}C NMR - Two-dimensional NMR spectra. - Applications and examples.	Lecture	Textbook: Ch. 8, pp. (164-200)
11	- **IR Spectroscopy "Sample preparation and analysis".**	Practical	Research lab
12	**Mass Spectroscopy:** - Basic theory of MS. - Ionization techniques.	Lecture	Textbook: Ch. 9, pp. (202-245)

	- Molecular fragmentation patterns. - Applications of MS in pharmaceutical analysis.		
13	**Combined structure problems:** - UV spec. - IR spec. - Mass spec. - ^{1}H and ^{13}C NMR	Lecture	Structure Elucidation
14	- **Thin Layer Chromatography.** - **Column Chromatography.**	Practical	Research lab
15	**Final Exam**		

** Learning styles: Lecture, flipped learning, learning through projects, learning through problem solving, participatory learning ... etc.*
*** Reference: Pages in a book, database, recorded lecture, content on the e-learning platform, video, website ... etc.*