澳門理工大學
Universidade Politécnica de Macau
Macao Polytechnic University

FACULTY OF HEALTH SCIENCES AND SPORTS

BACHELOR OF SCIENCE IN BIOMEDICAL TECHNOLOGY (PHARMACY TECHNOLOGY)

LEARNING MODULE OUTLINE

Academic Year	2025/2026	Semester	2
Module Code	BSPA2102		
Learning Module	Pharmaceutical Analysis		
Pre-requisite(s)	Analytical Chemistry		
Medium of Instruction	Chinese / English		
Credits	4	Contact Hours	60
Instructor	Dr. Tao Yi, Aaron	Email	yitao@mpu.edu.mo
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MODULE DESCRIPTION

This course is designed to help students apply the concepts of pharmaceutical analysis to their pharmacy practice. It consists of 37 hours of lectures, 15 hours of laboratory sessions, 4 hours of active learning and presentations, and 4 hours examinations, with a total of 60 teaching hours.

MODULE INTENDED LEARNING OUTCOMES (ILOS)

On completion of this learning module, students will be able to:

M1.	Demonstrate an understanding of the basic concepts of pharmaceutical analysis.
M2.	Describe theoretical backgrounds of the basic techniques in pharmaceutical analysis, including titration, UV spectroscopy, IR spectroscopy, GC, HPLC, TLC, extraction methods, capillary electrophoresis, Electrochemical biosensors, NMR, Mass spectrometry, Atomic emission spectrophotometry, Atomic absorption spectrophotometry, Fluorescence spectrophotometry, and Raman spectroscopy.
M3.	Apply the aforementioned basic techniques in pharmaceutical analysis into real pharmacy practice.
M4.	Perform the aforementioned basic techniques in pharmaceutical analysis according to pharmacopoeia specifications.
M5.	Develop SOP for the aforementioned basic techniques in pharmaceutical analysis.
M6.	Communicate scientific concepts effectively through oral presentations, demonstrating comprehension of pharmaceutical analysis principles.

These ILOs aims to enable students to attain the following Programme Intended Learning Outcomes (PILOs):

PILOs	M1	M2	M3	M4	M5	M6
P1. To demonstrate understanding of a range of subjects, fields, principles and approaches relevant to pharmacy technology	✓	✓	✓	✓	✓	✓
P2. To demonstrate understanding of theories, analytical approaches and practices that underpin pharmacy operations and management	✓	✓	✓	✓	✓	✓
P3. To demonstrate understanding of major trends and issues related to pharmacy technology	✓	✓	✓	✓		✓
P4. To apply professional knowledge and skills to analyse, interpret and solve problems, challenges and risks in pharmacy practice	✓		✓	✓	✓	
P5. To critically appraise and interpret scientific and clinical literature and apply evidence-based practice	✓			✓	✓	✓
P6. To acquire and apply research skills in pharmacy technology		✓	✓	✓	✓	✓
P7. To demonstrate effective communication and teamwork skills						✓
P8. To maintain professional and ethical standards in pharmacy practice and research	✓	✓	✓	✓	✓	✓

MODULE SCHEDULE, COVERAGE AND STUDY LOAD

Week	Content Coverage	Contact Hours

1	Chapter 1. Control of the quality of analytical methods (2h)
	  1.1 Introduction
	  1.2 Control of errors in analysis
	  1.3 Accuracy and precision
	  1.4 Validation of analytical procedures
	  1.5 Standard operating procedure
	  1.6 Compound random errors
	  1.7 Reporting of results
	  1.8 Other terms used in the control of analytical procedures
	  1.9 Basic calculations in pharmaceutical analysis
	
	Chapter 2. Physical and chemical properties of drug molecules (2h)
	  2.1 Calculation of pH value of aqueous solutions of strong and weak acids and bases
	  2.2 Acidic and basic strength and pKa
	  2.3 Henderson–Hasselbalch equation
	  2.4 Ionization of drug molecules
	  2.5 Buffers
	  2.6 Salt hydrolysis
	  2.7 Activity, ionic strength and dielectric constant
	  2.8 Partition coefficient
		4

2	Chapter 3. Titrimetric and chemical analysis methods (2h)
	  3.1 Introduction
	  3.2 Direct acid/base titrations in the aqueous phase
	  3.3 Indirect titrations in the aqueous phase
		6

	3.4 Non-aqueous titrations
	3.5 Argentometric titrations
	3.6 Complexometric titrations
	3.7 Redox titrations
	3.8 Iodometric titrations
	3.9 Ion pair titrations
	3.10 Diazotization titrations
	3.11 Potentiometric titrations
	3.12 Karl Fischer titration (coulometric end-point detection)
	3.13 Automatic titration
	3.14 Flow injection analysis
	
	Chapter 4. Ultraviolet and visible spectroscopy (2h)
	    4.1 Introduction
	    4.2 Factors governing absorption of radiation in the UV/visible region
	    4.3 Beer-Lambert law
	    4.4 Instrumentation
	    4.5 UV spectra of some representative drug molecules
	    4.6 Use of UV/visible spectrophotometry to determine pKa values
	    4.7 Applications of UV/visible spectroscopy to pharmaceutical quantitative analysis
	    4.8 Difference spectrophotometry
	        Applications of UV/visible spectroscopy in preformulation and formulation
	
	Chapter 5. Infrared spectrophotometry (4h)
	    5.1 Introduction
	    5.2 Factors determining intensity and energy level of absorption in IR spectra
	    5.3 Instrumentation		

3	5.4 Sample preparation
	5.5 Application of IR spectrophotometry in structure elucidation
	5.6 IR spectrophotometry as a fingerprint technique
	5.7 IR spectrophotometry as a method for identifying polymorphs
	
	Chapter 6. Extraction methods in pharmaceutical analysis (2h)
	    6.1 Introduction
	    6.2 Solvent extraction methods
	    6.3 Microdialysis extraction
	        Solid-phase extraction (SPE)
	
	Chapter 7. Chromatographic theory (2h)
	    7.1 Introduction
	    7.2 Void volume and capacity factor
	    7.3 Calculation of column efficiency
	    7.4 Origins of band broadening in HPLC
	    7.5 Parameters used in evaluating column performance
			6

4	Chapter 8. Thin-layer chromatography (2h)
	    8.1 Introduction
	    8.2 Thin Layer Chromatography
	    8.3 High Performance Thin Layer Chromatogarphy
			4

	Chapter 9. Gas chromatography (4h)
	    9.1 Introduction
	    9.2 Instrumentation	

5	9.3 Use of derivatization in GC
	    9.4 Applications of GC in quantitative analysis
	
	Chapter 10. High-performance liquid chromatography (6h)
	    10.1 Principles
	    10.2 Instrumentation
		4

6	10.3 Applications of HPLC to the quantitative analysis of drugs in formulations	4

9	Midterm **(2 hours on March 6th)**
	
	Chapter 11. High-performance capillary electrophoresis (3h)
	    11.1 Introduction
	    11.2 Instrumentation
	    11.3 Control of separation
	    11.4 Applications of CE in pharmaceutical analysis
	    11.5 Use of additives in the running buffer
	
	Chapter 12. Methods used in the quality control of biotechnologically produced drugs (3h)
	    12.1 Size exclusion chromatography
	    12.2 Sodium dodecyl sulphate polyacrylamide gel electrophoresis
	    12.3 Isoelectric focusing
	    12.4 Binding assays used in pharmacopoeial tests on protein drugs
	    12.5 Applications of ELISA in the pharmacopoeias
	    12.6 Radio-immunoassay
	    12.7 Polymerase chain reaction
		7

10	12.8 Capillary electrophoresis
	    12.9 Fingerprinting by HPLC and HPLC-MS
	    12.10 Circular dichroism
	    12.11 Other techniques used to assess protein secondary structure
	
	Practice 1: Assay for potassium permanganate
	Practice 2: Pharmaceutical Application of Fourier-Transform Infrared Spectroscopy
	
	Chapter 13. Electrochemical biosensors (3h)
	    13.1 Introduction
	    13.2 Basic principles of electrochemistry
	    13.3 Types of electrochemical biosensors
	    13.4 Instrumentation
	    13.5 Examples of biosensors utilized for pharmaceutical analysis
	    13.6 Limitations of biosensors in pharmaceutical analysis
		7

11	Practice 3: Assay for Aspirin tablet using two methods Active learning and presentation 1.1 Atomic emission spectrophotometry and Atomic absorption spectrophotometry	7

	1.2 Fluorescence spectrophotometry and Raman spectroscopy 1.3 Nuclear magnetic resonance spectroscopy 1.4 Mass spectrometry	
12	Practice 4: Extraction and TLC in pharmaceutical analysis Practice 5: Assay of cinnamaldehyde in cinnamon bark oil	3
14	Practice 6: HPLC in pharmaceutical analysis (Groups 1-4)	3
15	Practice 6: HPLC in pharmaceutical analysis (Groups 5-8)	3
16	Practice 7: Protein Gel Electrophoresis (Groups 1-4)	3
17	Practice 7: Protein Gel Electrophoresis (Groups 5-8)	3
18	Final (**2 hours on May 4th**)	2

TEACHING AND LEARNING ACTIVITIES

In this learning module, students will work towards attaining the ILOs through the following teaching and learning activities:

Teaching and Learning Activities	M1	M2	M3	M4	M5	M6
T1. Lectures with case studies and real-life examples	✓	✓	✓	✓	✓	
T2. Laboratory Practice	✓	✓	✓	✓	✓	✓
T3. Group discussion and presentations	✓	✓	✓	✓	✓	✓

ATTENDANCE

Attendance requirements are governed by the Academic Regulations Governing [Doctoral/Master's/Bachelor's] Degree Programmes of the Macao Polytechnic University. Students who do not meet the attendance requirements for the learning module shall be awarded an 'F' grade.

ASSESSMENT

In this learning module, students are required to complete the following assessment activities:

Assessment Activities	Weighting (%)	ILOs to be Assessed
A1. Presentation	5	M4, M5, M6
A2. Performance in class	5	M1, M2, M3
A3. Group discussions	5	M1, M2, M3, M4, M5, M6
A4. Laboratory Practice (Seven experiments)	5×7=35	M1, M2, M3, M4, M5, M6
A5. Midterm (Chapter 1 to Chapter 6)	25	M1, M2, M3, M4, M5
A6. Final exam (Chapter 7 to Chapter 13)	25	M1, M2, M3, M4, M5

This learning module is graded on a 100 point scale, with 100 being the highest possible score and 50 being the passing score.

Any students scoring less than 35% of the total mark in the final examination will be given an "F" grade for the module even if the overall grade is 50% or higher.

Make-up assessments will not be provided for the laboratory practice and midterm under any circumstances. Students who are absent will receive a score of zero for that assessment.

The assessment will be conducted following the University's Assessment Strategy (see www.mpu.edu.mo/teaching_learning/en/assessment_strategy.php). Passing this learning module indicates that students will have attained the ILOs of this learning module and thus acquired its credits.

MARKING SCHEME

Assessment Activities	Assessment Criteria	Mark Ranges				
		88-100	73-87	58-72	50-57	<50
A1. Presentation	Demonstrate the ability to apply pharmaceutical analysis knowledge to analyse and interpret practical cases and communicate scientific concepts effectively through oral presentations	Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels
A2. Performance in class	(1) Classroom Attitude and Conduct • Adheres to classroom rules: arrives on time, does not leave early, raises hand before speaking, and avoids interrupting others; • Shows respect for teachers and peers: speaks politely, accepts feedback positively, and listens attentively to others; • Avoids disruptive behaviors: stays seated appropriately, refrains from shouting or using electronic devices without permission.	Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels

		Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels
	(2) Focus and Engagement in Class • Listens attentively and stays focused; • Responds actively to instruction: answers questions accurately when called on and follows directions promptly. (3) Active Involvement in Class Activities • Participates proactively: volunteers to speak, raises questions, or shares opinions; • Engages meaningfully with the teacher: asks clarifying questions and provides feedback to deepen learning.					
A3. Group discussions	Demonstrate the ability to apply pharmaceutical analysis knowledge to analyse and interpret practical cases and communicate scientific concepts effectively through oral discussions	Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels
A4. Laboratory Practice	Demonstrate the ability to demonstrate understanding of theories, analytical approaches and practices, and apply the basic techniques in pharmaceutical analysis practice	Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels
A5. Midterm	Demonstrate the ability to understand, identify, and apply appropriate pharmaceutical analysis concepts,	Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels

	knowledge, and methods					
A6. Final exam	Demonstrate the ability to understand, identify, and apply appropriate pharmaceutical analysis concepts, knowledge, and methods	Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels

REQUIRED READINGS

Watson DG. 2021, Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists. 5th edition. London: Churchill Livingstone.

REFERENCES

Taijun Hang. 2022, Pharmaceutical analysis. 9th edition. Beijing: People's Medical Publishing House.

Lindon, John C; Tranter, George E; Koppenaal, David. 2017, Encyclopedia of spectroscopy and spectrometry, Third edition. Kidlington, Oxford: Academic Press is an imprint of Elsevier.

STUDENT FEEDBACK

At the end of every semester, students are invited to provide feedback on the learning module and the teaching arrangement through questionnaires. Your feedback is valuable for instructors to enhance the module and its delivery for future students. The instructor and programme coordinators will consider all feedback and respond with actions formally in the annual programme review.

ACADEMIC INTEGRITY

The Macao Polytechnic University requires students to have full commitment to academic integrity when engaging in research and academic activities. Violations of academic integrity, which include but are not limited to plagiarism, collusion, fabrication or falsification, repeated use of assignments and cheating in examinations, are considered as serious academic offenses and may lead to disciplinary actions. Students should read the relevant regulations and guidelines in the Student Handbook which is distributed upon the admission into the University, a copy of which can also be found at www.mpu.edu.mo/student_handbook/.