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	2024/2025	Semester	2
Module Code	BSPA2102		
Learning Module	Pharmaceutical Analysis		
Pre-requisite(s)	BSAC2101 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 aims to enable students to apply the concepts of pharmaceutical analysis in their pharmacy practice. This course has 40-hour lectures, 12-hour laboratory sessions, 4-hour active learning and presentation, 4-hour examination and 60 teaching hours in total.

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
	Chapter 1. Control of the quality of analytical methods 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	4
	Chapter 2. Physical and chemical properties of drug molecules 2.1 Introduction 2.2 Calculation of pH value of aqueous solutions of strong and weak acids and bases 2.3 Acidic and basic strength and pKa 2.4 Henderson–Hasselbalch equation 2.5 Ionization of drug molecules 2.6 Buffers 2.7 Salt hydrolysis 2.8 Activity, ionic strength and dielectric constant 2.9 Partition coefficient 2.10 Stereochemistry of drugs 2.11 Measurement of optical rotation	2

	2.12 Profiles of physico-chemical properties of some drug molecules	
	Chapter 3. Titrimetric and chemical analysis methods 3.1 Introduction 3.2 Instrumentation and reagents 3.3 Direct acid/base titrations in the aqueous phase 3.4 Titrations of the salts of weak bases in mixed aqueous/non-aqueous media 3.5 Indirect titrations in the aqueous phase 3.6 Non-aqueous titrations 3.7 Argentometric titrations 3.8 Complexometric titrations 3.9 Redox titrations 3.10 Iodometric titrations 3.11 Ion pair titrations 3.12 Diazotization titrations 3.13 Potentiometric titrations 3.14 Karl Fischer titration (coulometric end-point detection) 3.15 Automation of wet chemical methods 3.16 Applications of FIA in pharmaceutical analysis	2
	Chapter 4. Ultraviolet and visible spectroscopy 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 Diode array instruments 4.6 Instrument calibration 4.7 UV spectra of some representative drug molecules 4.8 Use of UV/visible spectrophotometry to determine pKa values 4.9 Applications of UV/visible spectroscopy to pharmaceutical quantitative analysis 4.10 Difference spectrophotometry 4.11 Derivative spectra 4.12 Applications of UV/visible spectroscopy in preformulation and formulation	3
	Chapter 5. Infrared spectrophotometry 5.1 Introduction 5.2 Factors determining intensity and energy level of absorption in IR spectra 5.3 Instrumentation 5.4 Sample preparation 5.5 Application of IR spectrophotometry in structure elucidation 5.6 Examples of IR spectra of drug molecules 5.7 IR spectrophotometry as a fingerprint technique 5.8 IR spectrophotometry as a method for identifying polymorphs 5.9 Near-infrared analysis (NIRA) 5.10 Examples of NIRA applications	4
	Practice 1: Assay for potassium permanganate Practice 2: Pharmaceutical Application of Fourier-Transform Infrared Spectroscopy	3

	Practice 3: Assay for Aspirin tablet using two methods	3
	Chapter 6. Extraction methods in pharmaceutical analysis 6.1 Introduction 6.2 Solvent extraction methods 6.3 Microdialysis extraction 6.4 Solid-phase extraction (SPE)	2
	Midterm	2
	Chapter 7. Chromatographic theory 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 7.6 Data acquisition 7.7 Report generation	2
	Chapter 8. Thin-layer chromatography 8.1 Introduction 8.2 Instrumentation 8.3 TLC chromatogram 8.4 Stationary phases 8.5 Elutropic series and mobile phases 8.6 Modification of TLC adsorbant 8.7 Detection of compounds on TLC plates following development 8.8 Applications of TLC analysis 8.9 High-performance TLC (HPTLC)	2
	Chapter 9. Gas chromatography 9.1 Introduction 9.2 Instrumentation 9.3 Selectivity of liquid stationary phases 9.4 Use of derivatization in GC 9.5 Summary of parameters governing capillary GC performance 9.6 GC detectors 9.7 Applications of GC in quantitative analysis 9.8 Determination of manufacturing and degradation residues by GC 9.9 Determination of residual solvents 9.10 Solid-phase microextraction (SPME) 9.11 Applications of GC in bioanalysis	4
	Chapter 10. High-performance liquid chromatography 10.1 Introduction 10.2 Instrumentation 10.3 Stationary and mobile phases 10.4 Structural factors which govern rate of elution of compounds from HPLC columns 10.5 More advanced consideration of solvent selectivity in reverse-phase chromatography 10.6 Effect of temperature on HPLC 10.7 Summary of stationary phases used in HPLC 10.8 A more advanced consideration of reverse-phase stationary phases	6

	10.9 Summary of detectors used in HPLC 10.10 Performance of a diode array detector 10.11 Applications of HPLC to the quantitative analysis of drugs in formulations 10.12 Assays involving more specialized HPLC techniques	
	Practice 4: Extraction and TLC in pharmaceutical analysis Practice 5: Assay of cinnamaldehyde in cinnamon bark oil according to BP2013	3
	Practice 6: HPLC in pharmaceutical analysis	3
	Chapter 11. High-performance capillary electrophoresis 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	3
	Chapter 12. Methods used in the quality control of biotechnologically produced drugs 12.1 Protein drugs 12.2 Protein structure 12.3 Instrumental techniques used in the analysis of biotechnologically produced drugs	3
	Chapter 13. Electrochemical biosensors 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	3
	Active learning and presentation 1.1 Atomic emission spectrophotometry and Atomic absorption spectrophotometry 1.2 Fluorescence spectrophotometry and Raman spectroscopy 1.3 Nuclear magnetic resonance spectroscopy 1.4 Mass spectrometry	4
	Final	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 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	7	M4, M5, M6
A2. Group discussions	8	M1, M2, M3, M4, M5, M6
A3. Laboratory Practice	5×6=30	M1, M2, M3, M4, M5, M6
A4. Midterm	25	M1, M2, M3, M4, M5
A5. Final exam	30	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.

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	Excellent	Good/ Very Good	Satisfactory	Marginal Pass	Fail; not reaching marginal levels

	effectively through oral presentations					
A2. 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
A3. 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
A4. Midterm	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
A5. 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/.