Macao Polytechnic Institute

School of Health Sciences and Sports

Bachelor of Science in Biomedical Technology

(Pharmacy Technology)

Module Outline

Academic Year 2020 / 2021 Semester 2

Learning Module	Pharmaceutical Analysis			**Class Code**	BSPA2102
Pre-requisite(s)	Nil				
Medium of Instruction	Chinese / English			**Credit**	4
Lecture Hours	39 hrs	**Lab/Practice Hours**	21 hrs	**Total Hours**	60 hrs
Instructor	Dr. Tao Yi, Aaron		**E-mail**	yitao@ipm.edu.mo	
Office	Room M707, 7/F, Meng Tak Building, Main Campus		**Telephone**	8599-3471	

Description

This learning module aims to enable students to apply the concepts of pharmaceutical analysis in their pharmacy practice. This course has 30-hour lectures, 21-hour laboratory sessions, 5-hour active learning and presentation, 4-hour examination and 60 teaching hours in total.

Learning Outcomes

After completing the learning module, students will be able to:

1. Describe theoretical backgrounds of the basic techniques in pharmaceutical analysis, including titration, UV spectroscopy, FTIR spectroscopy, GC / GC-MS, HPLC, TLC, extraction methods, NMR, Atomic emission spectrophotometry, Atomic absorption spectrophotometry, Fluorescence spectrophotometry, and Raman spectroscopy.
2. Apply the aforementioned basic techniques in pharmaceutical analysis into real pharmacy practice.
3. Perform the aforementioned basic techniques in pharmaceutical analysis according to pharmacopoeial specifications.
4. Develop SOP for the aforementioned basic techniques in pharmaceutical analysis.

Content

1. Introduction to pharmaceutical analysis (4 hours)
   - 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 (SOP)
   - 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

   (UNDERSTAND: describe the basic concepts of pharmaceutical analysis)

2. Titration in pharmaceutical analysis (3 hours)
   - 2.1 Direct acid/base titrations in the aqueous phase
   - 2.2 Indirect titrations in the aqueous phase
   - 2.3 Non-aqueous titrations
   - 2.4 Redox titrations
   - 2.5 Iodometric titrations
   - 2.6 SOP write-up in the assay for potassium permanganate according to BP2002

   (UNDERSTAND: describe the basic concepts of titration in pharmaceutical analysis. MASTER: apply the basic techniques of titration into real pharmacy practice.)

3. UV spectroscopy in pharmaceutical analysis (3 hours)
   - 3.1 Factors governing absorption of radiation in the UV/visible region
   - 3.2 Beer-Lambert law
   - 3.3 Instrumentation
   - 3.4 UV spectra of some representative drug molecules
   - 3.5 Use of UV/visible spectrophotometry to determine pKa values
   - 3.6 Applications of UV/visible spectroscopy to pharmaceutical quantitative analysis
   - 3.7 Difference spectrophotometry
   - 3.8 Applications of UV/visible spectroscopy in preformulation and formulation
   - 3.9 SOP write-up in the assay for Aspirin tablet according to BP2002

   (UNDERSTAND: describe the basic concepts of UV spectroscopy in pharmaceutical analysis. MASTER: apply the basic techniques of UV spectroscopy into real pharmacy practice.)

4. FTIR spectroscopy in pharmaceutical analysis (5 hours)
   - 4.1 Introduction
   - 4.2 Band Intensity in IR

4.3 Instrumentation
4.4 Sample preparation
4.5 Application of IR spectrophotometry in structure elucidation
4.6 IR spectrophotometry as a fingerprint technique
4.7 Infrared spectrophotometry as a method for identifying polymorphs
4.8 Peak assignments for 6 chemicals

(UNDERSTAND: describe the basic concepts of FTIR spectroscopy in pharmaceutical analysis.

MASTER: apply the basic techniques of FTIR spectroscopy into real pharmacy practice.)

5. Midterm (2 hours)

6. Extraction methods in pharmaceutical analysis (2 hours)
   6.1 Solvent extraction methods
   6.2 Microdialysis extraction
   6.3 Solid-phase extraction (SPE)

   (UNDERSTAND: describe the basic concepts of extraction methods in pharmaceutical analysis.)

7. Thin-layer chromatography (2 hours)
   7.1 Overview
   7.2 Thin Layer Chromatography (TLC)
   7.3 High Performance Thin Layer Chromatogarphy (HPTLC)

   (UNDERSTAND: describe the basic concepts of Thin-layer chromatography in pharmaceutical analysis.

   MASTER: apply the basic techniques of Thin-layer chromatography into real pharmacy practice.)

8. GC and GC-MS in pharmaceutical analysis (3 hours)
   8.1 Principles
   8.2 Instrumentation
   8.3 GC – Derivatization
   8.4 Applications

   (UNDERSTAND: describe the basic concepts of GC and GC-MS in pharmaceutical analysis.
   MASTER: apply the basic techniques of GC into real pharmacy practice.)

9. HPLC (8 hours)
   9.1 Overview
   9.2 Principles and instrumentation
   9.3 Applications

(UNDERSTAND: describe the basic concepts of HPLC in pharmaceutical analysis. MASTER: apply the basic techniques of HPLC into real pharmacy practice.)

10. Active learning and presentation (5 hours)

10.1 Atomic emission spectrophotometry

10.2 Atomic absorption spectrophotometry

10.3 Fluorescence spectrophotometry

10.4 Raman spectroscopy

10.5 Nuclear magnetic resonance spectroscopy

(UNDERSTAND: describe the basic techniques in pharmaceutical analysis.)

11. Practices (21 hours)

11.1 Practice 1: Assay for potassium permanganate according to BP2002 (3 hours)

11.2 Practice 2: Assay for Aspirin tablet using two methods (4 hours)

11.3 Practice 3: Pharmaceutical Application of Fourier-Transform Infrared (FTIR) Spectroscopy (2 hours)

11.4 Practice 4: Extraction and TLC in pharmaceutical analysis (3 hours)

11.5 Practice 5: Assay of cinnamaldehyde in cinnamon bark oil according to BP2013 (1 hours)

11.6 Practice 6: HPLC in pharmaceutical analysis (8 hours)

(MASTER: perform the aforementioned basic techniques in pharmaceutical analysis according to pharmacopoeial specifications and develop SOP for the aforementioned basic techniques in pharmaceutical analysis.)

12. Final (2 hours)

Date	Time	Content
27/01/2021	10:00-13:00	Chapter 1. Introduction to pharmaceutical analysis
02/02/2021	14:30-16:30	Chapter 2. Titration in pharmaceutical analysis
03/02/2021	10:00-13:00	Tutorial 1: SOP write-up in the assay for potassium permanganate according to BP2002 Chapter 3. UV spectroscopy in pharmaceutical analysis (I)
23/02/2021	14:30-16:30	Chapter 3. UV spectroscopy in pharmaceutical analysis (II) Tutorial 2: SOP write-up in the assay for Aspirin tablet according to BP2002
24/02/2021	**10:00-13:00**	**Practice 1: Assay for potassium permanganate according to BP2002**

02/03/2021	**14:30-18:30**	**Practice 2: Assay for Aspirin tablet using two methods**
03/03/2021	**11:00-13:00**	**Active learning I (Group discussion and presentation):** Atomic emission spectrophotometry **Active learning II (Group discussion and presentation):** Atomic absorption spectrophotometry
09/03/2021	**14:30-16:30**	**Active learning III (Group discussion and presentation):** Fluorescence spectrophotometry **Active learning IV (Group discussion and presentation):** Raman spectroscopy
10/03/2021	**11:00-13:00**	**Active learning V (Group discussion and presentation):** Nuclear magnetic resonance spectroscopy Chapter 4. FTIR spectroscopy in pharmaceutical analysis (I)
16/03/2021	14:30-16:30	Chapter 4. FTIR spectroscopy in pharmaceutical analysis (II)
17/03/2021	11:00-13:00	Tutorial 3: Peak assignments for 6 chemicals Chapter 5. Extraction methods in pharmaceutical analysis (I)
23/03/2021	**14:30-16:30**	**Practice 3: Pharmaceutical Application of Fourier-Transform Infrared (FTIR) Spectroscopy**
24/03/2021	11:00-13:00	Chapter 5. Extraction methods in pharmaceutical analysis (II) Chapter 6. Thin-layer chromatography (I)
30/03/2021	14:30-16:30	Chapter 6. Thin-layer chromatography (II)
31/03/2021	**10:00-13:00**	**Practice 4: Extraction and TLC in pharmaceutical analysis**
07/04/2021	**11:00-13:00**	**Midterm**
13/04/2021	14:30-16:30	Chapter 7. GC and GC-MS in pharmaceutical analysis (I)
14/04/2021	**11:00-13:00**	Chapter 7. GC and GC-MS in pharmaceutical analysis (II) **Practice 5: Assay of cinnamaldehyde in cinnamon bark oil according to BP2013**
20/04/2021	14:30-16:30	Chapter 8. HPLC (I)
21/04/2021	11:00-13:00	Chapter 8. HPLC (II)

27/04/2021	14:30-16:30	Chapter 8. HPLC (III)
28/04/2021	11:00-13:00	Chapter 8. HPLC (IV)
05/05/2021	**09:00-13:00**	**Practice 6: HPLC in pharmaceutical analysis (I)**
12/05/2021	**09:00-13:00**	**Practice 6: HPLC in pharmaceutical analysis (II)**
26/05/2021	**11:00-13:00**	**Final examination**

Teaching Method

Lectures, tutorials, videos, case studies, active learning, presentations, and class discussion. Approximately 10% of the course contents will be taught using active learning instructional strategies.

Attendance

Attendance requirements are governed by the "Academic Regulations Governing Bachelor's Degree Programmes of Macao Polytechnic Institute". Students are not eligible to attend the final examination and re-sit examination if the absence rate exceeds 30%. Moreover, an "F" will be given as the final grade to students who have less than the stated attendance for this enrolled module.

Assessment

This learning module is graded on a 100-score scale, with 100 being the full score and 50 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 course even if the overall grade is 50% or higher.

	Item	Description	Percentage
1.	Lab 1	Practical Report	5%
2.	Lab 2	Practical Report	5%
3.	Lab 3	Practical Report	5%
4.	Lab 4	Practical Report	5%
5.	Lab 5	Practical Report	5%
6.	Lab 6	Practical Report	5%
7.	Presentation	Active learning (Topic 10)	5%
8.	Group discussions	Case studies	5%
9.	Midterm		30%
10.	Final exam		30%
		Total Percentage:	100%

Teaching Material(s)

Textbook(s)

- Watson DG. 2017, Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists. 4th edition. London: Churchill Livingstone.

Reference

Reference book(s)

- Harry G Brittain. 2001, Analytical profiles of drug substances and excipients. Academic Press.
- Dengkui An. 2001, Selected topics on modern pharmaceutical analysis. China Medical Science and Technology Press.