



# Course Specification

(Bachelor)

**Course Title:** Pharmaceutical Analytical Chemistry-2

**Course Code:** PHCH 314

**Program:** Pharmaceutical Sciences

**Department:** Pharmaceutical Chemistry

**College:** Pharmacy

**Institution:** Najran University

**Version:** 3

**Last Revision Date:** 18/11/2024

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## A. General information about the course:

### 1. Course Identification

1. Credit hours: 3 ( 2+1 )

#### 2. Course type

A. ☐ University ☐ College ☐ Department ☐ Track ☒ Program  
B. ☒ Required ☐ Elective

3. Level/year at which this course is offered: (5<sup>th</sup> Level / 3<sup>rd</sup> year)

#### 4. Course general Description:

This course deals with describing and explaining theoretical background and principles that are used for quantitative analysis of substances including fundamentals of redox and complexometry titrations as well as fundamentals of high pressure liquid chromatography (HPLC), UV-VIS, IR and Raman spectroscopy. Also, the course deals with identification and applying the validation parameters of the analytical methods. The practical part deals with training students on different types of titrations, mathematical calculations and formulas needed for calculation of the final concentrations as well as identifying and operating the instruments.

#### 5. Pre-requirements for this course (if any):

PHCH 213

#### 6. Co-requisites for this course (if any):

None

#### 7. Course Main Objective(s):

- 1- Explain the main principles and fundamentals of the quantitative volumetric analysis of substances such as Redox and complexometry titrations
- 2- Apply the different types of volumetric titrations professionally
- 3- Demonstrate the main principles and fundamentals of the different instrumental techniques such as UV, IR, Raman and HPLC
- 4- Demonstrate practical skills for preparation of standards and operating instruments

### 2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> <li>Traditional classroom</li> <li>E-learning</li> </ul>		





No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning		

### 3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	30
2.	Laboratory/Studio	30
3.	Field	0
4.	Tutorial	0
5.	Others (specify)	0
Total		60

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Describe the fundamentals of UV-VIS spectrophotometry, IR, Raman, and electrochemical methods and their application as well as the validation parameters of the analytical instrumental analysis.	K3	Lectures	Written exam Assignments
2.0	Skills			
2.1	Plan strategies for the solution of analytical problems	S1	Lectures Problem-based learning	Written exam
2.2	Demonstrate practical skills of preparation of standards and and	S3	Laboratory work Problem-based learning	Practical exam





Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	operating instruments			
2.3	Communicate clearly by verbal and written means using chemical terms	S5	Laboratory work	Reports Assignment
3.0	Values, autonomy, and responsibility			
3.1	Demonstrate effective and reasonable solutions for rising problems based on the available information, accountability, confidence, and independent thinking	V4	Practical sessions	Observation cards

### C. Course Content (theoretical)

No	List of Topics	Contact Hours
1.	<b><u>Introduction</u></b> Applying the validation parameters of the analytical instrumental analysis. 1- Linearity (calibration curve and regression line) 2- Accuracy 3- Precision 4- Selectivity a. Specificity	5
2.	<b><u>UV-VIS spectroscopy</u></b> 1. Absorption of UV-VIS radiations 2. Types of electronic transitions and their wavelengths 3. Factors affecting ultraviolet absorption. 4. Beer's Lambert Law for quantitative analysis 5. Deviations from Beer's Lambert law 6. Instrumentation of UV-VIS spectrophotometers • Application of the UV-VIS absorption in the pharmaceutical analysis of drug substances	5
3.	<b><u>IR spectroscopy</u></b> 1. Absorption of IR radiations 2. Types of vibrations and their wavelengths 3. Factors affecting IR absorption. 4. Instrumentation of IR spectrophotometers • Application of IR in determination of functional groups	5
4.	<b><u>Raman spectroscopy (FES)</u></b>	4





	<ul style="list-style-type: none"> <li>a- Raman Spectroscopy</li> <li>b- Difference between Raman and normal IR spectroscopy</li> <li>c- Quantitation using Raman spectroscopy                             <ul style="list-style-type: none"> <li>• Instrumentation of Raman spectroscopy</li> </ul> </li> </ul>	
5.	<b><u>High Performance Liquid Chromatography (HPLC)</u></b> <ol style="list-style-type: none"> <li>1. Definitions of all parts of HPLC (Instrumentation)</li> <li>2. Modes of separation analysis by using HPLC</li> <li>3. Qualitative and quantitative analysis by using HPLC.</li> </ol> Chromatographic parameters of HPLC analysis	4
6.	<b><u>Volumetric Titrations</u></b> <ol style="list-style-type: none"> <li>a. Fundamentals of oxidation-reduction titrations</li> <li>b. Oxidation-reduction indicators and titration curves</li> <li>c. Redox reagents and their applications</li> <li>d. Application of redox systems in biological systems</li> </ol>	4
7.	<ol style="list-style-type: none"> <li>a. Fundamentals of complexometric titrations</li> <li>b. Metallochromic indicators and complexon reagents</li> <li>c. Application of complexometric EDTA titrations and how to increase EDTA selectivity</li> <li>d. Masking and demasking</li> </ol>	3
<b>Total</b>		<b>30</b>

### Course Content (Practical)

No	List of Topics	Contact Hours (P)
1.	<ol style="list-style-type: none"> <li>1- Introduction to laboratory health and safety procedures and tools names</li> <li>2-Lab 1. Beer's Lambert Law plot</li> <li>3- Lab 2. Determination of pharm. compounds by UV</li> <li>4- Lab 3. IR spectra (e.g. paracetamol, and aspirin).</li> <li>5- Lab 4. HPLC components and functions</li> <li>6- Lab 5. Quantitative HPLC analysis</li> <li>7- Lab 6. Redox titration of ferrous sulphate by <math>\text{KMnO}_4</math></li> <li>8- Lab 7. Complexometric titration of <math>\text{Ca}^{2+}</math> by EDTA</li> <li>9- Statistics in laboratory</li> <li>10- Data Analysis using excel software</li> <li>11- Practical Exam week number 11</li> </ol>	30
<b>Total</b>		<b>30</b>



## D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	5	10
2.	Midterm	7-9	20
3.	Assignment	12	5
4.	Observation card	2-13	10
5.	Practical reports or Practical quiz	12	5
6.	Final Practical exam	16	10
7.	Final theoretical exam	17-19	40
8.	Total		100

\*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

Essential References	1. Vogel's Quantitative chemical Analysis, 7th Edition, 2009 2. Analytical Chemistry by Christian, G.D. 7th Edition, John Wiley and Sons: New York, 2014.
Supportive References	1. Vogel's Quantitative chemical Analysis, 7th Edition, 2009 2. Power point slides
Electronic Materials	<a href="http://www.dlaf.nu.edu.sa">www.dlaf.nu.edu.sa</a>
Other Learning Materials	Excel software for calculations and drawing

### 2. Required Facilities and equipment

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Suitable lecture room equipped with data show and internet and sufficient number of seats. Suitable laboratories equipped with health and safety tools, internet and sufficient number of seats.
<b>Technology equipment</b> (projector, smart board, software)	Computers, data show, sound systems and internet
<b>Other equipment</b> (depending on the nature of the specialty)	1. Volumetric flasks of different volumes 2. Conical flasks 3. Burets 4. Water bath 5. Hot plates 6. Automatic pipettes 7. Ultrasonic instrument 8. pH meters 9. UV-VIS spectrophotometer





Items	Resources
	10. HPLC instrument 11. Raman spectroscopy

## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Head of departments and students	Indirect Questionnaires (indirect)
Effectiveness of Students assessment	Faculty members and students	Indirect Questionnaires (indirect)
Quality of learning resources	Students	Questionnaires (Indirect)
The extent to which CLOs have been achieved	Student peer reviewer	Direct Indirect
Other		

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	Pharmaceutical Chemistry Department Council
<b>REFERENCE NO.</b>	<b>4-2024</b>
<b>DATE</b>	18/11/2024

