

Academic Program Description Form

University Name: Al-Nahrain

Faculty/Institute: College of Pharmacy

Scientific Department: Pharmaceutical chemistry

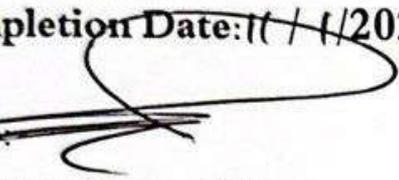
Academic or Professional Program Name: Pharmaceutical chemistry

Final Certificate Name: Bachelor's Degree

Academic System: Courses

Description Preparation Date: 5/1/2026

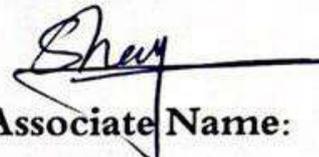
File Completion Date: 11/1/2026

Signature: 

Head of Department Name:

Prof. Dr. Mohammed Jasim

Date: 25/2/2026

Signature: 

Scientific Associate Name:

Assistant Professor

Dr. Shaimaa Hussein Hammoudi

Date: 25/2-2026

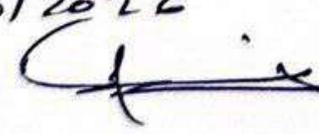
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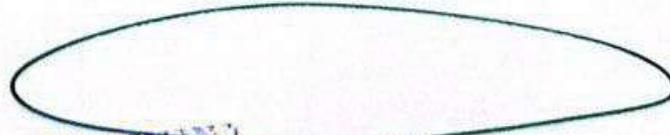
Department of Quality Assurance and University Performance

Director of the Quality Assurance and University Performance Department:

Dr. Noor Adil Abood

Date: 8/3/2026

Signature: 


Approval of the Dean

Professor Dr. Hayder Bahaa Sahib



**Ministry of Higher Education and Scientific Research
Scientific Supervision and Scientific Evaluation Apparatus
Directorate of Quality Assurance and Academic Accreditation
Accreditation Department**



Academic Program and Course Description Guide

2026–2025

Introduction:

The educational program is a well-planned set of courses that include procedures and experiences arranged in the form of an academic syllabus. Its main goal is to improve and build graduates' skills so they are ready for the job market. The program is reviewed and evaluated every year through internal or external audit procedures and programs like the External Examiner Program.

The academic program description is a short summary of the main features of the program and its courses. It shows what skills students are working to develop based on the program's goals. This description is very important because it is the main part of getting the program accredited, and it is written by the teaching staff together under the supervision of scientific committees in the scientific departments.

This guide, in its second version, includes a description of the academic program after updating the subjects and paragraphs of the previous guide in light of the updates and developments of the educational system in Iraq, which included the description of the academic program in its traditional form (annual, quarterly), as well as the adoption of the academic program description circulated according to the letter of the Department of Studies T 3/2906 on 3/5/2023 regarding the programs that adopt the Bologna Process as the basis for their work.

In this regard, we can only emphasize the importance of writing an academic programs and course description to ensure the proper functioning of the educational process.

Concepts and terminology:

Academic Program Description: The academic program description provides a brief summary of its vision, mission and objectives, including an accurate description of the targeted learning outcomes according to specific learning strategies.

Course Description: Provides a brief summary of the most important characteristics of the course and the learning outcomes expected of the students to achieve, proving whether they have made the most of the available learning opportunities. It is derived from the program description.

Program Vision: An ambitious picture for the future of the academic program to be sophisticated, inspiring, stimulating, realistic and applicable.

Program Mission: Briefly outlines the objectives and activities necessary to achieve them and defines the program's development paths and directions.

Program Objectives: They are statements that describe what the academic program intends to achieve within a specific period of time and are measurable and observable.

Curriculum Structure: All courses / subjects included in the academic program according to the approved learning system (quarterly, annual, Bologna Process)

whether it is a requirement (ministry, university, college and scientific department) with the number of credit hours.

Learning Outcomes: A compatible set of knowledge, skills and values acquired by students after the successful completion of the academic program and must determine the learning outcomes of each course in a way that achieves the objectives of the program.

Teaching and learning strategies: They are the strategies used by the faculty members to develop students' teaching and learning, and they are plans that are followed to reach the learning goals. They describe all classroom and extra-curricular activities to achieve the learning outcomes of the program.

1. Program Vision

Enhancing the quality of education, scientific research, and practical training

2. Program Mission

The College of Pharmacy is one of the pillars of the medical triangle concerned with human health. To provide high-quality education and training using the latest technology in all major and minor specialties TO prepare pharmacists with high scientific and professional skills and capabilities. To disseminate pharmaceutical culture, provide pharmaceutical care to the community, and develop the aspect of scientific research, which is essential for the localization of Iraqi medicine

3. Program Objectives

- 1- Preparing competent pharmacists qualified both practically and scientifically to work in healthcare institutions including hospitals, health centers, pharmaceutical laboratories, quality control, forensic medicine, and in all administrative aspects related to the technical affairs department in the Ministry of Health in all its branches, as well as in the private sector, particularly in pharmaceutical promotion.
- 2- Training pharmacists holding advanced degrees capable of being significant contributors to Iraqi universities, research institutions, and healthcare facilities
- 3- Directing scientific research to be foundational in the fields of pharmaceutical industry and solving health problems. Scientific research should focus on modifying or suggesting drug dosages or therapeutic protocols.

4. Program Accreditation

Does the program have program accreditation? And from which agency?

5. Other external influences

Is there a sponsor for the program?

6. Program Structure

Program Structure	Number of Courses	Credit hours	Percentage	Reviews*
Institution Requirements	10	435		
College Requirements	10	345		
Department Requirements	10	345		
Summer Training	–	–		
Other	–	–		

* This can include notes whether the course is basic or optional.

7. Program Description

Year/Level	Course Code	Course Name	Credit Hours	
			theoretical	practical
1 st / 1 st semester	PHC113	Analytical Chemistry	3 hours	2 hours
1 st / 2 nd semester	PHC124	Organic Chemistry I	3 hours	2 hours
2 nd /1 st semester	PHC211	Organic Chemistry II	3 hours	2 hours

2 nd /2 nd semester	PHC221	Organic Chemistry III	3 hours	2 hours
3 rd / 1 st semester	PHC311	Inorganic Pharmaceutical Chemistry	3 hours	2 hours
3 rd / 2 nd semester	PHC321	Organic Pharmaceutical Chemistry I	3 hours	2 hours
4 th / 1 st semester	PHC412	Organic Pharmaceutical Chemistry II	3 hours	2 hours
4 th / 2 nd semester	PHC422	Pharmaceutical Organic Chemistry III	2 hours	2 hours
5 th / 1 st semester	PHC511	Pharmaceutical Organic Chemistry IV	2 hours	
5 th / 2 nd semester	PHC524	Advanced Pharmaceutical Analysis	3 hours	2 hours
Master/ 1 st semester		Advanced analytical Chemistry	2 hours	
Master/ 2 nd semester		Advanced Organic Chemistry	2 hours	
Master/ 2 nd semester		Instrument Lab Techniques	2 hours	

8. Expected learning outcomes of the program

Knowledge

Learning Outcomes 1

1-Training students in the proper and safe practices for handling chemical materials, glassware, and laboratory instruments; providing instruction on the analytical techniques used to identify various chemical substances; and teaching the different methods and techniques employed in the synthesis and preparation of chemical compounds.

2-Studying the chemical and physical properties of drugs and chemical substances, while training students to accurately draw and name the structural formulas of pharmaceutical and chemical compounds according to systematic nomenclature rules.

3-Exploring modern approaches to the design of chemical compounds using advanced computer-based modeling and simulation software.

4-Teaching students the mechanisms of action of drugs and chemical substances, and examining how structural modifications affect biological activity, solubility, stability, side effects, and the duration of drug action.

Skills

Learning Outcomes 2

The skills goals special to the program

- 1 - Acquisition of the skill on how to identify and evaluate chemical compounds
- 2 - Acquisition of skill in the use of various methods of preparation and manufacture of chemical compounds
- 3- Acquiring the skill in writing scientific reports

Learning Outcomes 3

Ethics

Learning Outcomes 4

- Proper handling of chemical materials and glassware.
- Operating scientific instruments correctly and appropriately.
- Gaining experience in using various techniques for the preparation of drugs and chemical compounds.
- Understanding the mechanisms of action of drugs.
- Understanding the factors that affect biological activity, solubility, stability, side effects, and the duration of drug action.
- Studying chemical reaction mechanisms and pathway

9. Teaching and Learning Strategies

- Theoretical lectures with discussions
- Practical lectures with laboratory skills
- Reports
- Oral examinations
- Presentation slides
- Whiteboard
- Smart board
- Guidelines
- Case study
- Small group assignments

10. Evaluation methods

- Theoretical examination
- Practical examination
- In-class activities
- Homework assignments
- Oral discussions
- Reports
- Audit skills
- Personal reflection

11. Faculty

Faculty Members

Academic Rank	Specialization		Special Requirements/Skills (if applicable)	Number of the teaching staff	
	General	Special		Staff	Lecturer
Professor	2			15	10
Assistant professor	0				
Teacher	4				
Assistant teacher	8				

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Professional Development

Mentoring new faculty members

1. Monitoring new faculty members by attending classroom lectures.
2. Providing guidance in developing teaching skills.
3. Encouraging the development of research skills.
4. Promoting the development of leadership skills.
5. Providing guidance in improving practical skills.
6. Encouraging decision-making skills.
7. Guiding faculty members on proper methods and approaches for interacting with students.

Professional development of faculty members

Enhancing the performance and skills of faculty members according to the latest developments in teaching within pharmaceutical and chemical fields to ensure that the department continues on the correct scientific path.

- Elevating the scientific quality of research and promoting participation in conferences and scientific seminars.
- Encouraging the scientific and cultural activities of the faculty staff within the department.

12. Acceptance Criterion

(Central Admission at the Ministry of Higher Education and Scientific Research / Iraq / according to the student's grades)

Master's Program: Students are evaluated based on the performance in the competitive exam (30%) and the student's GPA (70%).

13. The most important sources of information about the program

State briefly the sources of information about the program.

14. Program Development Plan

Syllabus development plan by adding or updating a Syllabus

Program Skills Outline

				Required program Learning outcomes											
Year/Level	Course Code	Course Name	Basic or optional	Knowledge				Skills				Ethics			
				A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4
First year/ first semester	PHC113	Analytical chemistry	Basic	√	√	√	√	√	√	√	√	√	√	√	√
		Practical Analytical chemistry	Basic	√	√	√	√	√	√	√	√	√	√	√	√
First year / second semester	PHC124	Organic chemistry I	Basic	√	√	√	√	√	√	√	√	√	√	√	√
		Practical Organic chemistry I	Basic	√	√	√	√	√	√	√	√	√	√	√	√
Second year/ first semester	PHC211	Organic chemistry II	Basic	√	√	√	√	√	√	√	√	√	√	√	√
		Practical Organic chemistry II	Basic	√	√	√	√	√	√	√	√	√	√	√	√

Second year / second semester	PHC221	Organic chemistry III	Basic	√	√	√	√	√	√	√	√	√	√	√	√
		Practical Organic chemistry III	Basic	√	√	√	√	√	√	√	√	√	√	√	√
Third year/first semester	PHC311	Inorganic pharmaceutical chemistry	Basic	√	√	√	√	√	√	√	x	√	√	√	√
		Practical Inorganic pharmaceutical chemistry		√	√	√	√	√	✓	✓	✓	✓	✓	✓	✓
Third year / second semester	PHC321	Organic pharmaceutical chemistry I	Basic	√	√	√	√	√	√	√	√	√	√	x	√
Forth year / first semester	PHC412	Organic pharmaceutical chemistry II	Basic	√	√	√	√	√	√	√	√	√	√	√	√
		Practical Organic		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

		pharmaceutical chemistry II													
Forth year / second semester	PHC422	Organic pharmaceutical chemistry III	Basic	√	√	√	√	√	√	√	√	√	√	√	√
		Practical Organic pharmaceutical chemistry III		√	√	√	√	√	√	√	√	√	√	√	√
Fifth year / first semester		Organic pharmaceutical chemistry IV	Basic	√	√	√	√	√	√	√	√	√	√	√	√
		Practical Organic pharmaceutical													

		tical chemistry IV													
Fifth year / second semester		Advanced pharmaceu tical Analysis	Basic	√	√	√	√	√	√	√	√	x	√	√	√
Master / First semester		Advanced Analytical Chemistry	Basic	√	√	√	√	√	√	√	√	√	√	√	√
Master / second semester		Advanced Organic Chemistry	Basic	√	√	√	√	√	√	√	√	√	√	√	√
Master / second semester		Lab Instrumen t Technique S	Basic	√	√	√	√	√	√	√	√	√	√	√	√

- Please tick the boxes corresponding to the individual program learning outcomes under evaluation.

Course Description Form

1. Course Name:					
Analytical Chemistry					
2. Course Code:					
PHC113					
3. Semester / Year:					
1st Semester/ First Stage					
4. Description Preparation Date:					
2025					
5. Available Attendance Forms:					
Attendance					
6. Number of Credit Hours (Total) / Number of Units (Total)					
45 hours / 4credit					
7. Course administrator's name (mention all, if more than one name)					
Name: prof. Dr mohammed jassim Hamzah Email: dr.mohammed.jasim@nahrainuniv.edu.iq					
8. Course Objectives					
Course Objectives			1- Analytical Chemistry: Student Preparation 2- Providing support with information related to qualitative and quantitative chemical analyses 3- Studying the theories related to this.		
9. Teaching and Learning Strategies					
Strategy		1- Theoretical Lectures 2- Practical Lab Skills 3- Whiteboard 4- Interactive Electronic Whiteboard 5- Seminars (Questions and Discussion) 6- Homework			
10. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3		Introduction to Analyti	Lectures	Oral and written exam

			Chemistry: Types and roles in drug development and QC		
2	4		Review of Basic Concepts: Concentration units, standards, solution preparation	Lectures	Oral and written exam
3	4		Introduction to Pharmacopoeias: USP, BP, monographs, specifications	Lectures	Oral and written exam
4	2		Case Study: Interpreting pharmacopoeial monographs and ICH Q2(R1) overview	Lectures	Oral and written exam
5-6	5		Gravimetric Analysis: Precipitation, weighing, error sources	Lectures	Oral and written exam
7-8	5		Volumetric Analysis I: Acid-base titrations, indicators, pH, calculations	Lectures	Oral and written exam
9	3		Volumetric Analysis II: Precipitation and Complexometric titrations (Mohr, EDTA(Lectures	Oral and written exam
10	3		Redox Titrations: Principles, iodometry, permanganometry	Lectures	Oral and written exam
11-12	7		Statistical Evaluation of Data: Mean, SD, confidence limits, Q-test, Grubbs test	Lectures	Oral and written exam
13	3		UV-Visible Spectrophotometry: Principles, Beer's Law, applications	Lectures	Oral and written exam
14	3		Electrochemical Methods:	Lectures	Oral and written exam

			Potentiometry, Conductometry		
15	3		Introduction to Chromatography: TLC, paper chromatography	Lectures	Oral and written exam

11. Course Evaluation

Annual assessment: 40%, theoretical exam: 20% + practical exam: 20%
 *(20% midterm exam + daily exams)
 Final exam: 60% theoretical only
 Final grade: 100%

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Fundamentals of Analytical Chemistry by Sto and West.
Main references (sources)	Fundamentals of Analytical Chemistry by Sto and West.
Recommended books and references (scientific journals, reports...)	Analytical Chemistry by Stook and West
Electronic References, Websites	

Course Description Form

1. Course Name:	
Practical Analytical Chemistry	
2. Course Code:	
PHC113	
3. Semester / Year	
1st Semester/ First Stage	
4. Description Preparation Date:	
24/4/2025	
5. Available Attendance Forms:	
Attendance	
6. Number of Credit Hours (Total) / Number of Units (Total)	
30 hours / 1credit	
7. Course administrator's name (mention all, if more than one name)	
Name: Assistant Lecturer Yasir Mohammed Email: yasir.kinaan@nahrainuniv.edu.iq Assistant lecturer : Hussein Naser Salman Hussein.Naser@nahrainuniv.edu.iq	
8. Course Objectives	
Course Objectives	Preparing the students and supporting them with information related to qualitative and quantitative chemical analyses and studying the theories related that.
9. Teaching and Learning Strategies	
Strategy	1-Conducting scientific experiments 2-Acquiring skills in drug preparation 3-Building student confidence through presenting scientific research 4-Acquiring skills in drug identification and classification
10. Course Structure	

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2	Laboratory safety rules	Demonstration of some laboratory equipment.	Practical	Lab-based and quiz
2	2	Glass ware laboratory	Volumetric method of analysis	Practical	Lab-based and quiz
3	2	Prepare solutions from liquids	Preparation and standardization of HCl solution (known)	Practical	Lab-based and quiz
4	2	Titration principles	Preparation and standardization of HCl solution (Unknown)	Practical	Lab-based unknown quiz
5	2	Prepare solutions from solid	Preparation and standardization of NaOH solution	Practical	Lab-based unknown quiz
6	2	Titration of HCl with Sodium carbonate	Determination of the percentage of acetic acid	Practical	Lab-based unknown quiz
7	2	Titration of HCl with NaOH	Analysis of sodium carbonate and sodium hydroxide mixture.	Practical	Lab-based unknown quiz
8	2	Titration of KMnO ₄ with oxalate acid	Determination of chlorid by the Mohr method	Practical	Lab-based unknown quiz
9	2	unknown sample determination)	Determination of chlorid by the Volhard method.	Practical	Lab-based unknown quiz
10	2	Determination of chloride by Mohr method unknown sample determination	Determination of ferrous form of iron in Mohr's salt.	Practical	Lab-based unknown quiz
11	2	Determination of water hardness	Determination of total hardness in tap water.	Practical	Lab-based unknown quiz
12	2	unknown sample determination	Gravimetric determination of Nickel.	Practical	Lab-based unknown quiz

11. Course Evaluation

the score out of 20 is distributed according to the tasks assigned to the student, such as daily preparation, daily exams, oral and monthly exams, written tests, reports, etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Fundamentals of Analytical Chemistry Stook and West.
Main references (sources)	Fundamentals of Analytical Chemistry Stook and West.

Recommended books and references (scientific journals, reports...)	Analytical Chemistry by Stook and West
Electronic References, Websites	

Course Description Form

13. Course Name:	Organic Chemistry I
14. Course Code:	PHC124
15. Semester / Year:	Second semester– first stage
16. Description Preparation Date:	2025
17. Available Attendance Forms:	Attendance
18. Number of Credit Hours (Total) / Number of Units (Total)	45 hr / 3 credit
19. Course administrator's name (mention all, if more than one name)	Name: dr. ahmad thamer +dr. ghassan qais Email: dr. ghassan.qais@nahrainuniv.edu.iq dr. ahamed.thamer@nahrainuniv.edu.iq
20. Course Objectives	
Course Objectives	1-Understanding how to handle organic chemical compounds & their reactions

2-How to handle scientific instruments.
 3-Learning through the use of various scientific techniques.
 4-Knowing the methods used in the preparation of organic compounds.

21. Teaching and Learning Strategies

Strategy

1- How to handle organic chemical compounds and their reactions.
 2-How to handle scientific instruments.
 3- Learning using various scientific techniques.
 4-Knowledge of methods used in the preparation of organic compounds.

22. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3		An introduction	Lectures	Oral and written ex
3-2	6		Alkanes and methane	Lectures	Oral and written ex
5-4	6		Alkenes 1 and 2	Lectures	Oral and written ex
6	3		Alkynes and Dienes	Lectures	Oral and written ex
7-8	6		Stereochemistry 1	Lectures	Oral and written ex
9-10	6		Alcohols and Ethers	Lectures	Oral and written ex
11-12	6		Benzene	Lectures	Oral and written ex
13	3		Cyclic alkenes	Lectures	Oral and written ex
14-15	6		Alkyl halides.	Lectures	Oral and written ex

23. Course Evaluation

Annual assessment: 40%, theoretical exam: 20% + practical exam: 20%
 *(20% midterm exam + daily exams)
 Final exam: 60% theoretical only
 Final grade: 100%

24. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed.
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	Thomason learning; CA,USA; 2015
Main references (sources)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed. Thomason learning; CA,USA; 2015
Recommended books and references (scientific journals, reports...)	Leroy G. Wade - Organic Chemistry-Pearson (2016)
Electronic References, Websites	

Course Description Form

1. Course Name:
Practical Organic Chemistry I
2. Course Code:
PHC124
3. Semester / Year:
Second semester– first stage
4. Description Preparation Date:
2025
5. Available Attendance Forms:
Attendance
6. Number of Credit Hours (Total) / Number of Units (Total)
30 hour / 1 credit
7. Course administrator's name (mention all, if more than one name)

Name: Assistant Lecturer Yasir Mohammed
 Email: yasir.kinaan@nahrainuniv.edu.iq
 Assistant lecturer : Hussein Naser Salman
 Hussein.Naser@nahrainuniv.edu.iq

8. Course Objectives

Course Objectives

1. Study of the classification, properties, preparation, and reactions of alkanes, alkenes, alkynes, alcohols, ethers, benzene, and the study of stereochemistry.
2. Understanding how to handle organic chemical compounds and their reactions.
3. How to handle scientific equipment.
4. Learning using various scientific techniques.
5. Knowledge of methods used in the preparation of organic compounds.

9. Teaching and Learning Strategies

Strategy

- 1- Conducting scientific experiments
- 2- Acquiring the skill of preparing medications
- 3- Building the student's confidence through presenting scientific research
- 4- Acquiring the skill of identifying and classifying medications

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1-2	4	Determination of melting point	Determination of melting point	Practical	Lab-based unknown quiz
3-4	4	Determination of boiling point	Determination of boiling point	Practical	Lab-based unknown quiz
5-6	4	Re-crystallization	Re-crystallization	Practical	Lab-based unknown quiz
7-8	4	Distillation technique	Distillation technique	Practical	Lab-based unknown quiz
9-10	4	Determination of solubility class	Determination of solubility class	Practical	Lab-based unknown quiz

11. Course Evaluation

the score out of 20 is distributed according to the tasks assigned to the student, such as daily

preparation, daily exams, oral and monthly exams, written tests, reports, etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed. Thomson learning; CA,USA; 2015
Main references (sources)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed. Thomson learning; CA,USA; 2015
Recommended books and references (scientific journals, reports...)	Leroy G. Wade - Organic Chemistry- Pearson (2016)
Electronic References, Websites	

Course Description Form

1. Course Name:
Organic Chemistry II
2. Course Code:
PHC211
3. Semester / Year:
first semester – second stage
4. Description Preparation Date:
2025
5. Available Attendance Forms:

Attendance					
6. Number of Credit Hours (Total) / Number of Units (Total)					
45hour/ 2 credit					
7. Course administrator's name (mention all, if more than one name)					
Name: dr. Ahmad thamer + dr. ghassan.qais Email: dr. ghassan.qais@nahrainuniv.edu.iq dr. ahamed.thamer@nahrainuniv.edu.iq					
8. Course Objectives					
Course Objectives		1- How to handle organic chemical compounds and their reactions. 2- How to handle scientific equipment. 3- Learning using various scientific techniques. 4- Knowledge of methods used in preparing organic compounds.			
9. Teaching and Learning Strategies					
Strategy	<ul style="list-style-type: none"> • Lectures, homework, tests, practical lab • Preparation of various chemical compounds and medicines • Identifying chemical compounds, medicines, and their derivatives • Conducting chemical analyses 				
10. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
3-1	6		Alkyl halides.	Lectures	Oral and written exam
3-4	5		Stereochemistry II.	Lectures	Oral and written exam
7-5	12		Aldehydes and ketones	Lectures	Oral and written exam

			(include also aldol and Claisen Condensation); Classification reactions and properties.		
9-8	5		Carboxylic acids: Properties and reactions.	Lectures	Oral and written exam
11-10	6		Functional derivatives of carboxylic acids.	Lectures	Oral and written exam
13-12	6		Amines I and II.	Lectures	Oral and written exam
15-14	5		Amines I and II.	Lectures	Oral and written exam

11. Course Evaluation

Annual assessment: 40%, theoretical exam: 20% + practical exam: 20%

*(20% midterm exam + daily exams)

Final exam: 60% theoretical only

Final grade: 100%

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed. Thomason learning; CA,USA; 2015
Main references (sources)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed. Thomason learning; CA,USA; 2015
Recommended books and references (scientific journals, reports...)	Leroy G. Wade - Organic Chemistry-Pearson (2016)
Electronic References, Websites	

Course Description Form

1. Course Name:

Practical Organic Chemistry II

2. Course Code: PHC211	
3. Semester / Year: first semester- second stage	
4. Description Preparation Date: 2025	
5. Available Attendance Forms: Attendance	
6. Number of Credit Hours (Total) / Number of Units (Total) 30 hour/ 1 credit	
7. Course administrator's name (mention all, if more than one name) Name: lecturer soura read + Assistant teacher baqer.abdulitef Email: soura.hammoudy@nahrainuniv.edu.iq baqer.abdulitef@nahrainuniv.edu.iq	
8. Course Objectives	
Course Objectives	<ul style="list-style-type: none"> 1- Conducting scientific experiments 2- Acquiring skills in drug preparation 3- Granting confidence to the student through presenting scientific research 4- Acquiring the skill of detecting and classifying drugs
9. Teaching and Learning Strategies	
Strategy	<ul style="list-style-type: none"> 1- How to handle organic chemical compounds and their reactions. 2- How to handle scientific equipment. 3- Learning through the use of various scientific techniques. 4- Understanding the methods used in the preparation of organic compounds

10. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1-2	4		Determination solubility class	Practical	Known sample
3-4	4		Determination of solubility class	Practical	Quiz and unknown
5-6	4		Identification of alcohols	Practical	Known sample
7-8	4		Identification of alcohols	Practical	Quiz and unknown
8-9	4		Identification of phenols	Practical	Known sample
10-11	4		Identification of phenols	Practical	Quiz and unknown
12-13	4		Identification of aldehydes and ketones	Practical	Known sample
14-15	4		Identification of aldehydes and ketones	Practical	Quiz and unknown

11. Course Evaluation

The grade is distributed out of 20 based on the tasks assigned to the student, such as daily preparation, daily exams, oral and written exams, reports, etc.

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed. Thomason learning; CA,USA; 2015
Main references (sources)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd . Organic Chemistry by McCurry; 9th ed. Thomason learning; CA,USA; 2015
Recommended books and references (scientific journals, reports...)	Leroy G. Wade - Organic Chemistry- Pearson (2016)
Electronic References, Websites	

Course Description Form

1. Course Name:	
Organic Chemistry III	
2. Course Code:	
PHC 221	
3. Semester / Year:	
second semester- second stage	
4. Description Preparation Date:	
2025	
5. Available Attendance Forms:	
Attendance	
6. Number of Credit Hours (Total) / Number of Units (Total)	
45hour/ 2 credit	
7. Course administrator's name (mention all, if more than one name)	
Name: dr ahmad thamer + dr. ghassan gais Email: dr. ahmad.thamer@nahrainuniv.edu.iq dr. ghassan .gais @nahrainuniv.edu.iq	
8. Course Objectives	
	<p>1-how to handle organic chemical compounds and their reactions.</p> <p>2- How to handle scientific instruments.</p> <p>3- Learning through the use of various scientific techniques.</p> <p>4- Understanding the methods used in the preparation of organic compounds.</p>
9. Teaching and Learning Strategies	
Strategy	<p>1-How to deal with chemical compounds</p> <p>2- How to deal with scientific equipment</p> <p>3- Learning using different scientific techniques</p> <p>4- Knowing the methods used in preparing medicines</p>

1- Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1-4	13		Heterocyclic system: Classes of heterocyclic systems; general structures; properties; Occurrence in nat and in medicinal products.	Lectures	Oral and written exam
5	3		Five-membered ring heterocyclic compounds: pyrrole; furan and thiophen.	Lectures	Oral and written exam
6	3		Source of pyrrole, furan and thiophen.	Lectures	Oral and written exam
9-7	8		Electrophilic substitution in pyrrole, furan and thiophen: Reactivity and orientation.	Lectures	Oral and written exam
10	2		Six-membered ring heterocyclic compounds: Structure of pyridine.	Lectures	Oral and written exam
11	1		Basicity of pyridine.	Lectures	Oral and written exam
13-11	7		Reactions of pyridine.	Lectures	Oral and written exam
15-14	8		Saturated five-membered heterocyclic compounds.	Lectures	Oral and written exam
2- Course Evaluation					
Annual assessment: 40%, theoretical exam: 20% + practical exam: 20% *(20% midterm exam + daily exams) Final exam: 60% theoretical only Final grade: 100%					
3- Learning and Teaching Resources					
Required textbooks (curricular books, if any)			Organic Chemistry by Robert T. Morrison and Robert N. Boyd, latest edition. Organic Chemistry by J. McMurry, latest ed., Thomason learning, CA, USA		
Main references (sources)			An introduction to the chemistry of heterocyclic compound by Acheson, R. M. latest ed.		

Recommended books and references (scientific journals, reports...)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd, latest edition. Organic Chemistry by J. McMurry, latest ed., Thomson learning, CA, USA. An introduction to the chemistry of heterocyclic compound by Acheson, R. M. latest ed.
Electronic References, Websites	

Course Description Form

10.	Course Name:		
		Practical Organic Chemistry III	
11.	Course Code:	PHC221	
12.	Semester / Year:		
		second semester- second stage	
13.	Description Preparation Date:		
		2025	
14.	Available Attendance Forms:		
		Attendance	
15.	Number of Credit Hours (Total) / Number of Units (Total)		
		30hour/ 1 credit	
16.	Course administrator's name (mention all, if more than one name)		
		Name: lecturer soura read + Assistant teacher baqer.abdulitef	
		Email: soura.hammoudy@nahrainuniv.edu.iq baqer.abdulitef@nahrainuniv.edu.iq	
17.	Course Objectives		
		<p>1- Preparation of chemical compounds and various medications.</p> <p>2-Identification of chemical compounds, medications, and their derivatives.</p> <p>3-Performing chemical analyses.</p>	
18.	Teaching and Learning Strategies		
	Strategy		

- 1- Acquiring the skill in preparing compounds and medications.
- 2- Acquiring the skill in using various methods for manufacturing and preparing medications.
- 3- Acquiring the skill in handling chemical compounds.
- 4- Acquiring the skill in writing scientific reports.

4- Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1-2	4		Identification of carboxylic acid	Practical	known sample
3-4	4		Identification of carboxylic acid	Practical	quiz and unknown
5-6	4		Identification of Alkyl and Aryl Halides	Practical	known sample
7-8	4		Identification of Alkyl and Aryl Halides	Practical	quiz and unknown
8-9	4		Salts of carboxylic acids	Practical	known sample
10-11	4		Salts of carboxylic acids	Practical	quiz and unknown
12-13	4		Classification of reactions of amines	Practical	known sample
14-15	4		Classification of reactions of amines	Practical	quiz and unknown

5- Course Evaluation

The grade is distributed out of 20 based on the tasks assigned to the student, such as daily preparation, daily exams, oral and written exams, reports, etc.

6- Learning and Teaching Resources

Required textbooks (curricular books, if any)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd, latest edition. Organic Chemistry by J. McMurry, latest ed., Thomson learning, CA, USA. An introduction to the chemistry of heterocyclic compound by Acheson, R. M. latest ed.
Main references (sources)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd, latest edition. Organic Chemistry by J. McMurry, latest ed., Thomson learning, CA, USA. An introduction to the chemistry of

	heterocyclic compound by Acheson, R. M. latest ed.
Recommended books and references (scientific journals, reports...)	Organic Chemistry by Robert T. Morrison and Robert N. Boyd, latest edition. Organic Chemistry by J. McMurry, latest ed., Thomson learning, CA, USA. An introduction to the chemistry of heterocyclic compound by Acheson, R. M. latest ed.
Electronic References, Websites	

Course Description Form

1. Course Name: Inorganic Pharmaceutical Chemistry
2. Course Code: PHC311
3. Semester / Year: first semester – third stage
4. Description Preparation Date: 2025
5. Available Attendance Forms: attendance
6. Number of Credit Hours (Total) / Number of Units (Total) 45 hr / 3 credit
7. Course administrator's name (mention all, if more than one name)
Name: assist. Lecturer Tiba M. Hameed Email: teba.majed@nahrainuniv.edu.iq Name : Assistant Lecturer Asmaa Adnan Abdul-nabi Email: asmaa.adnan@nahrainuniv.edu.iq
8. Course Objectives

Course Objectives	<p>-This course examines the clinical application of inorganic compounds focusing on the relationship between chemical structure and therapeutic or diagnostic function.</p> <p>-Students will study the roles of key metals in medicine, including platinum anticancer agents and chelation therapy.</p> <p>-A significant component is dedicated to radiopharmacy, covering the principles, safe handling, and application of radiopharmaceuticals in advanced medical imaging and treatment.</p>
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9. Teaching and Learning Strategies

Strategy	<p>-This course examines the clinical application of inorganic compounds, focusing on the relationship between chemical structure and therapeutic or diagnostic function.</p> <p>-Students will study the roles of key metals in medicine, including platinum anticancer agents and chelation therapy.</p> <p>-A significant component is dedicated to Radiopharmacy, covering the principles, safe handling, and application of radiopharmaceuticals in advanced medical imaging and treatment.</p>
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10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2	Alkali Metals: Lithium, Sodium, Potassium: Electron configuration, chemical properties of metals	Alkali Metals: Lithium, Sodium, Potassium: Electron configuration, chemical properties of metals	Lectures	Oral and written exams
2	2	Alkaline Earth Metals	Alkaline Earth Metals	Lectures	Oral and written exams
3	4	Group 13: Aluminium, Boron and Gallium	Group 13: Aluminium, Boron and Gallium	Lectures	Oral and written exams
4	2	The Carbon Group: General chemistry of group 14 elements	The Carbon Group: General chemistry of group 14 elements	Lectures	Oral and written exams
5	4	Transition Metals and d-Block Metal Chemistry	Transition Metals and d-Block Metal Chemistry	Lectures	Oral and written exams
6	2	Chelation Therapy	Chelation Therapy	Lectures	Oral and written exams
7	2	Protective adsorbents	Protective adsorbents	Lectures	Oral and written exams
8	2	Topical agents	Topical agents	Lectures	Oral and written exams
9	2	Dental agents	Dental agents	Lectures	Oral and written exams
10	2	Organometallic Chemistry	Organometallic Chemistry	Lectures	Oral and written exams
11	4	Radioactive Compounds and Their Clinical Application	Radioactive Compounds and Their Clinical Application	Lectures	Oral and written exams

12	2	Radiopharmaceuticals imaging	Radiopharmaceuticals imaging	Lectures	Oral and written exams
11. Course Evaluation					
Annual assessment: 40%, theoretical exam: 20% + practical exam: 20% *(20% midterm exam + daily exams) Final exam: 60% theoretical only Final grade: 100%					
12. Learning and Teaching Resources					
Required textbooks (curricular books, if any)			Inorganic Medicinal and Pharmaceutical Chemistry by Block, Roche Soine and Wilson, latest edition Wilson and Gisvold; Textbook of Organic medicinal and Pharmaceutical chemistry; Delgado JN, Remers WA, (eds); latest edition		
Main references (sources)			Inorganic Medicinal and Pharmaceutical Chemistry by Block, Roche Soine and Wilson, latest edition		
Recommended books and references (scientific journals, reports...)					
Electronic References, Websites					

Course Description Form

1. Course Name: Practical Inorganic Pharmaceutical Chemistry
2. Course Code: PHC311
3. Semester / Year: first semester - third stage
4. Description Preparation Date: 2025
5. Available Attendance Forms: attendance
6. Number of Credit Hours (Total) / Number of Units (Total) 30 hr / 1 credit

7. Course administrator's name (mention all, if more than one name)

Name: Dr.Rawa Muhsen + Assist.teacher baqer.abdulitef + Assist.teacher Shahad Wajih

Email: [:dr.rawa.muhsen@nahrainuniv.edu.iq](mailto:dr.rawa.muhsen@nahrainuniv.edu.iq)
baqer.abdulitef@nahrainuniv.edu.iq
s.alsaji@yahoo.com

8. Course Objectives

Course Objectives

The study of inorganic chemical compounds and their uses in medical diagnosis and treatment, and teaching students how to estimate inorganic compounds and drugs.

9. Teaching and Learning Strategies

Strategy

- 1 - Acquire skills in preparing compounds and medicines
- 2 - Acquire skills in using different methods in manufacturing and preparing medicines
- 3 - Acquire skills in handling chemical compounds
- 4 - Acquire skills in writing scientific reports and conducting scientific experiments
- 5 - Build student confidence through presenting scientific research
- 6 - Acquire skills in detecting, classifying, and evaluating medicines

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2	Definition and application in the medical and pharmaceutical field	To prepare and sublimation of calcium carbonate (CaCO_3).	procedure	Oral and written exams
2	2	Definition and application in the medical and pharmaceutical field	To prepare and sublimation of magnesium carbonate (MgCO_3)	procedure	Oral and written exams
3	2	Definition and application in the medical and pharmaceutical field	To prepare and sublimation of Zinc sulphate (ZnSO_4)	procedure	Oral and written exams
4	2	Definition and application in the medical and pharmaceutical field	To prepare and sublimation of Potash alum ($\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24 \text{H}_2\text{O}$)	procedure	Oral and written exams
5	2	Definition and application in the medical and pharmaceutical field	To prepare and sublimation of Boric acid (H_3BO_3)	procedure	Oral and written exams
6	2	Definition and application in the medical and pharmaceutical field	To prepare and sublimation of aluminum hydroxide	procedure	Oral and written exams

		pharmaceutical field			
7	2	Definition and application of the medical pharmaceutical field	To perform limit test for iron in given sample.	procedure	Oral and written exams
8	2	Definition and application of the medical pharmaceutical field	To perform limit test for chloride in given sample.	procedure	Oral and written exams
9	2	Definition and application of the medical pharmaceutical field	To perform limit test for sulphate in given sample.	procedure	Oral and written exams
10	2	Definition and application of the medical pharmaceutical field	To perform identification test for boric acid.	procedure	Oral and written exams
11	2	Definition and application of the medical pharmaceutical field	To perform identification test for ammonium chloride.	procedure	Oral and written exams
12	2	Definition and application of the medical pharmaceutical field	Acid neutralisation capacity of aluminium hydroxide gel	procedure	Oral and written exams
13	2		(unknown sample).	procedure	exams
14	2		(unknown sample).	procedure	exams
15	2		(unknown sample).	procedure	exams

11. Course Evaluation

The grade is distributed out of 20 based on the tasks assigned to the student, such as daily preparation, daily exams, oral and written exams, reports, etc.

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Inorganic Medicinal and Pharmaceutical Chemistry by Block, Roche Soine and Wilson, latest edition Wilson and Gisvold; Textbook of Organic medicinal and Pharmaceutical chemistry; Delgado JN, Remers WA, (eds); latest edition
Main references (sources)	Inorganic Medicinal and Pharmaceutical Chemistry by Block, Roche Soine and Wilson, latest edition Wilson and Gisvold; Textbook of Organic medicinal and Pharmaceutical chemistry; Delgado JN, Remers WA, (eds); latest edition
Recommended books and references (scientific)	Inorganic Medicinal and Pharmaceutical

journals, reports...)	Chemistry by Block, Roche Soine and Wilson, latest edition
Electronic References, Websites	

Course Description Form

1. Course Name: Organic Pharmaceutical Chemistry I
2. Course Code: PHC321
3. Semester / Year: second semester – third stage

4. Description Preparation Date: 2025

5. Available Attendance Forms: attendance

6. Number of Credit Hours (Total) / Number of Units (Total) 45 hr / 3 credit

7. Course administrator's name (mention all, if more than one name)

Name: assist. Lecturer Tiba M. Hameed

Email: teba.majed@nahrainuniv.edu.iq

Name : Assistant Lecturer Asmaa Adnan Abdul-nabi

Email: asmaa.adnan@nahrainuniv.edu.iq

8. Course Objectives

Course Objectives

This course provides a comprehensive overview of the core principles governing how drugs interact with the human body, from metabolism and distribution to receptor binding and therapeutic action.

The curriculum is structured to first explain what the body does to a drug (pharmacokinetics), then detail the principles of rational drug design (pharmacodynamic

9. Teaching and Learning Strategies

Strategy

This course provides a **comprehensive overview** of the core principles governing how drugs interact with the human body, from **Metabolism and Distribution to Receptor Binding and Therapeutic Action**.

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1-7	14	Studying the SAR	Drug design strategies	Lectures	Oral and written exams
8-12	8	Introduction to Prodrug	Prodrug	Lectures	Oral and written exams
13-15	6	Introduction to metabolic processes	Drug metabolism	Lectures	Oral and written exams

11. Course Evaluation

Annual assessment: 30%, theoretical exam:

*(25% midterm exam + 5% daily exams)

Final exam: 70% theoretical only

Final grade: 100%

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Main references (sources)	An Introduction to Medicinal Chemistry 5th Edition by Graham L. Patrick, University of the West of Scotland, UK
Recommended books and references (scientific journals, reports...)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Electronic References, Websites	

Course Description Form

25.	Course Name: Organic Pharmaceutical Chemistry II				
26.	Course Code: PHC 412				
27.	Semester / Year: first semester – forth stage				
28.	Description Preparation Date: 2025				
29.	Available Attendance Forms: attendance				
30.	Number of Credit Hours (Total) / Number of Units (Total) 45 hr / 3 credit				
31.	Course administrator's name (mention all, if more than one name)				
	Name: Lecturer Dr. Ammar Abdul Hussein Hamid Ammar.abd@nahrainuniv.edu.iq Name: assist. Lecturer Tiba M. Hameed Email: teba.majed@nahrainuniv.edu.iq				
32.	Course Objectives				
Course Objectives	This course offers an in-depth exploration of the pharmaceutical chemistry and pharmacology of major drug classes that target key physiological systems. The curriculum focuses on the relationship between chemical structure and biological activity (SAR), the mechanism of action at specific receptors, and the therapeutic applications of these agents in treating various diseases.				
33.	Teaching and Learning Strategies				
Strategy	<ul style="list-style-type: none"> - Structure-Activity Relationship (SAR): Studying the relationship between chemical structure and biological activity. - Mechanism of Action (MOA): Exploring the mechanism of action of these therapeutic agents at specific receptors. - Therapeutic Applications: Studying the therapeutic applications of these drugs in treating various diseases. 				
34.	Course Structure				
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1-4	12	Knowledge of medications used to treat disorders of the cholinergic system	Drugs used to treat cholinergic system disorders	Lectures	Oral and written exams

5-7	9	Knowledge of the adrenergic system	Drugs used to treat adrenergic system disorders	Lectures	Oral and written exams
8-10	7	knowledge of the CNS acting drugs	CNS drugs	Lectures	Oral and written exams
11,12	5	Knowledge	Drugs affecting cardiovascular system	Lectures	Oral and written exams
13,14	7	Knowledge of steroids	Histamine and anti-histaminic agents	Lectures	Oral and written exams
15	5	Knowledge of nonsteroidal anti-inflammatory drugs	NSAIDS	Lectures	Oral and written exams

35. Course Evaluation

Annual assessment: 40%, theoretical exam: 20% + practical exam: 20%

*(20% midterm exam + daily exams)

Final exam: 60% theoretical only

Final grade: 100%

36. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Wilson and Gisvold; Textbook of Organic medicinal and Pharmaceutical chemistry; Delgado JN, Remers WA, (eds); latest edition
Main references (sources)	Foye's Principles of Medicinal Chemistry Roche PhD (Author), S. William PhD Zito 7 th Edition PhD by Victoria PhD F. , College of Pharmacy, Houston Uni, Texas, USA.
Recommended books and references (scientific journals, reports...)	
Electronic References, Websites	

Course Description Form

13.	Course Name: Practical Organic Pharmaceutical Chemistry II					
14.	Course Code: PHC412					
15.	Semester / Year: first semester – forth stage					
16.	Description Preparation Date: 2025					
17.	Available Attendance Forms: attendance					
18.	Number of Credit Hours (Total) / Number of Units (Total) 30 hr / 1 credit					
19.	Course administrator's name (mention all, if more than one name)					
	Name: Assist. Lecturer Kany Azad+ Assist. Lecturer Shahad Wajih + Assist. Lecturer Hussein Nasser Email: kany.azad@nahrainuniv.edu.iq Hussein.Naser@nahrainuniv.edu.iq s.alsaji@yahoo.com					
20.	Course Objectives					
	Course Objectives	<ol style="list-style-type: none"> 1. Knowledge of drug and chemical compound design methods. 2. Knowledge of laboratory synthesis methods for drugs and chemical compounds. 3. Learning laboratory analysis methods to determine the composition of chemical compounds. 4. Preparation of various drugs. 				
21.	Teaching and Learning Strategies					
	Strategy	<ol style="list-style-type: none"> 1- Conducting scientific experiments 2- Gaining skills in preparing medicines 3- Building student confidence through conducting scientific research 4- Gaining skills in identifying and classifying medicines 				
22.	Course Structure					
	Week	Hours	Required Learning	Unit or subject name	Learning	Evaluation

		Outcomes		method	method
1	2	Definition and application in the pharmaceutical field	Preparation of Salicylic acid.	Theoretical and practical lectures	Practical, written and oral exams. In addition to reports.
2	2	Definition and application in the pharmaceutical field	Re-crystallization of salicylic acid.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
3	2	Definition and application in the pharmaceutical field	Synthesis of aspirin.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
4	2	Definition and application in the pharmaceutical field	Re-crystallization of aspirin.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
5	2	Definition and application in the pharmaceutical field	Assay of aspirin (known sample).	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
6	2	Definition and application in the pharmaceutical field	Assay of aspirin (unknown sample).	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
7	2	Definition and application in the pharmaceutical field	Preparation of nitrobenzene.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
8	2	Definition and application in the pharmaceutical field	Preparation of aniline.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
9	2	Definition and application in the pharmaceutical field	Preparation of acetanilide	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
10	2	Definition and application in the pharmaceutical field	Re-crystallization of acetanilide.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
11	2	Definition and application in the pharmaceutical field	Chlorosulfonation of acetanilide.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
12	2	Definition and application in the pharmaceutical field	Amination of <i>p</i> -chlorobenzenesulfonyl chloride.	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
13	2	Definition and application in the pharmaceutical field	Hydrolysis of <i>p</i> -chlorobenzenesulfonyl chloride to sulfanilamide	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
14	2	Definition and application in the pharmaceutical field	Synthesis of paracetamol	Theoretical practical lectures	Practical, written, oral exams. In addition to reports.
15	2	Definition and	Schiff base reaction	Theoretical	Practical, written,

		application in the pharmaceutical field		practical lectures	oral exams. In addition to reports.
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23. Course Evaluation

The grade is distributed out of 20 based on the tasks assigned to the student, such as daily preparation, daily exams, oral and written exams, reports, etc.

24. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Main references (sources)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Recommended books and references (scientific journals, reports...)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Electronic References, Websites	

Course Description Form

1. Course Name: Organic Pharmaceutical Chemistry III	
2. Course Code: PHC 422	
3. Semester / Year: second semester – forth stage	
4. Description Preparation Date: 2025	
5. Available Attendance Forms: attendance	
6. Number of Credit Hours (Total) / Number of Units (Total) 45 hr / 3 credit	
7. Course administrator's name (mention all, if more than one name)	
Name: Lecturer Dr. Ammar Abdul Hussein Hamid Ammar.abd@nahrainuniv.edu.iq Name: assist. Lecturer Tiba M. Hameed Email: teba.majed@nahrainuniv.edu.iq	
8. Course Objectives	
Course Objectives	-This course covers the medicinal chemistry and pharmacology of chemotherapeutic drugs. It details the mechanisms of anticancer agents, from traditional antineoplastics to modern biotherapeutics. -The curriculum also provides an in-depth analysis of major antibacterial classes (including β -lactams and

sulfonamides) and concludes with an overview of **antiviral** and **antifungal** agents.

9. Teaching and Learning Strategies

Strategy	<p>1- Covers the Medicinal Chemistry and Pharmacology of chemotherapeutic drugs.</p> <p>2-Details the mechanisms of anticancer agents, from traditional antineoplastics to modern biotherapeutics.</p> <p>3-Provides an in-depth analysis of major antibacterial classes (including β-lactams and sulfonamides).</p> <p>4-Concludes with an overview of antiviral and antifungal agents.</p>
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10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1-7	20	Identifying different types of anticancer	Anticancer agents	Lectures	Oral and written exams
8-12	18	Identifying different types of antibiotics.	antibiotics	Lectures	Oral and written exams
13,14	5	Identifying different types of antivirals.	antivirals	Lectures	Oral and written exams
15	2	Identifying different types of antifungals.	antifungals	Lectures	Oral and written exams

11. Course Evaluation

Annual assessment: 40%, theoretical exam: 20% + practical exam: 20%
 *(20% midterm exam + daily exams)
 Final exam: 60% theoretical only
 Final grade: 100%

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Wilson and Gisvold; Textbook of Organic medicinal and Pharmaceutical chemistry; Delgado JN, Remers WA, (eds); latest edition
Main references (sources)	Foye's Principles of Medicinal Chemistry Roche PhD (Author), S. William PhD Zito 7 th Edition PhD by Victoria PhD F. , College of Pharmacy, Houston Uni, Texas, USA.
Recommended books and references (scientific journals, reports...)	An Introduction to Medicinal Chemistry 7th Edition by Graham L. Patrick, University of the West of Scotland, UK
Electronic References, Websites	

Course Description Form

1. Course Name: Practical Organic Pharmaceutical Chemistry III	
2. Course Code: PHC422	
3. Semester / Year: second semester – forth stage	
4. Description Preparation Date: 2025	
5. Available Attendance Forms: attendance	
6. Number of Credit Hours (Total) / Number of Units (Total) 30 hr / 1 credit	
7. Course administrator's name (mention all, if more than one name) Name: assist. Lecturer Kany Azad + Assist. Lecturer Shahad Wajih+ Assist. Lecturer Hussein Nasser Email: kany.azad@nahrainuniv.edu.iq Hussein.Naser@nahrainuniv.edu.iq s.alsaji@yahoo.com	
8. Course Objectives	
Course Objectives	1- How to handle chemical compounds

	2- How to handle scientific equipment 3- Learning how to use various scientific techniques 4- Understanding the factors that affect the stability, solubility, and absorption of drugs 5- Understanding the mechanism of drug action and the relationship between chemical composition and this 6- Understanding the methods used in drug preparation
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9. Teaching and Learning Strategies

Strategy	1- Conducting scientific experiments 2- Gaining skills in preparing medicines 3- Building student confidence through presenting scientific research 4- Gaining skills in identifying and classifying medicines
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10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2	Definition and application in the pharmaceutical field	Hydrolytic Degradation of Ceftriaxone and Detection of β -Lactam Ring Cleavage	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
2	2	Definition and application in the pharmaceutical field	Demonstration of Acidic Instability of Benzylpenicillin (Penicillin G)	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
3	2	Definition and application in the pharmaceutical field	Comparative Stability Study of Azithromycin and Erythromycin	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
4	2	Definition and application in the pharmaceutical field	Comparing the acid stability of Azithromycin and Erythromycin	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
5	2	Definition and application in the pharmaceutical field	Comparative In Vitro Evaluation of Oral Absorption Potential of Tetracycline Class Antibiotics	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
6	2	Definition and application in the pharmaceutical field	Demonstration of the Amphoteric Nature of Tetracyclines	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
7	2	Definition and application in the pharmaceutical field	Simulation of Tetracycline Inactivation by Calcium from Milk and Antacids	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
8	2	Definition and application in the pharmaceutical field	Effect of pH on the Solubility of Ciprofloxacin and its Clinical Relevance to Crystalluria	Theoretical practical lectures	Practical, written and oral exams. In addition to reports.
9	2	Definition and	Demonstration of Metal Ion	Theoretical	Practical, written

		application in the pharmaceutical field	Chelation by Quinolones (e.g. Ciprofloxacin)	practical lectures	and oral exams. In addition reports.
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11. Course Evaluation

The grade is distributed out of 20 based on the tasks assigned to the student, such as daily preparation, daily exams, oral and written exams, reports, etc.

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Main references (sources)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Recommended books and references (scientific journals, reports...)	Wilson and Gisvold Textbook of Organic medicinal and Pharmaceutical chemistry, Delgado JN, Remers WA, (Eds); 12th ed, 2011.
Electronic References, Websites	

Course Description Form

37. Course Name:	Organic Pharmaceutical Chemistry IV
38. Course Code:	PHC 511
39. Semester / Year:	1 st Semester / 5 th Year
40. Description Preparation Date:	2025
41. Available Attendance Forms:	In-person
42. Number of Credit Hours (Total) / Number of Units (Total)	45 hours (theoretical and practical) / 2 Units
43. Course administrator's name (mention all, if more than one name)	Name: Lecturer Dr. Ammar Abdul Hussein

E Mail: Ammar.abd@nahrainuniv.edu.iq
 Name: Assistant lecturer Kanar Muthanna
 Email: Kanar.muthana@nahrainuniv.edu.iq

44. Course Objectives

Course Objectives	To provide students with knowledge of and experience in pro-drug and hormones as part of their medicinal and pharmaceutical field. It includes classification, synthesis, biotransformation and/or formulation of certain drugs to improve their action as well as to avoid some side effects.
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45. Teaching and Learning Strategies

Strategy	.The teaching strategy for this course, which focuses on Pro-drugs and Hormones, should combine theoretical foundations (Pharmaceutical Chemistry) with practical application (Drug Design).
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46. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	6	Basic concepts of prodrugs	Basic concepts of prodrugs	Lectures	Oral and written exams
2	6	Chemical delivery systems; Polymeric prodrugs;.	Chemical delivery systems; Polymeric prodrugs;.	Lectures	Oral and written exams
3	4	Drug targeting.	Drug targeting.	Lectures	Oral and written exams
4	4	Project.	Project.	Lectures	Oral and written exams
5	5	Combinatorial chemistry;	Combinatorial chemistry;	Lectures	Oral and written exams
6	5	Detection, purification and analgesics; Encoding combinatorial libraries;	Detection, purification and analgesics; Encoding combinatorial libraries;	Lectures	Oral and written exams

47. Course Evaluation

Annual assessment 30%,
 *(25% midterm exam + 5 %daily exams)
 Final exam 70% theoretical only
 Final grade 100%

48. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Wilson and Gisvold Textbook of Organic Medicinal and Pharmaceutical Chemistry, Delgado JN, Remers WA, (Eds.); Late Edition.
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Main references (sources)	
Recommended books and references (scientific journals, reports...)	
Electronic References, Websites	

Course Description Form

49. Course Name:
Advanced Pharmaceutical Analysis
50. Course Code:
PHC 524
51. Semester / Year:
2 ^{ed} Semester / 5 th Year
52. Description Preparation Date:

2025					
53. Available Attendance Forms:					
In-person					
54. Number of Credit Hours (Total) / Number of Units (Total)					
30 hours (theoretical only) / 2 Units					
55. Course administrator's name (mention all, if more than one name)					
Name: Professor Dr. Mohammed Jassim Hamzah Email: dr.mohammed.jasim@nahrainuniv.edu.iq Name: Professor Dr. Ahmed Thamer Email: dr.ahmad.thamer@nahrainuniv.edu.iq					
56. Course Objectives					
Course Objectives			To study spectrometric methods used for identification and characterization of organic compounds, including UV, IR, MASS and NMR spectroscopy; it enables students to understand the applications of these techniques for qualitative and quantitative analysis of organic compounds.		
57. Teaching and Learning Strategies					
Strategy		Key Instruments: Includes four main techniques: <ul style="list-style-type: none"> • UV (Ultraviolet): To determine the presence of double bonds and chromophores. • IR (Infrared): To determine the functional groups present in the molecule. • MASS (Mass Spectrometry): To determine the compound's Molecular Weight and its fragmentation to obtain a unique fingerprint. • NMR (Nuclear Magnetic Resonance): To determine the Carbon and Hydrogen framework of the compound and how the atoms are connected. 			
58. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
2-1	6	1. Using ultraviolet radiation to detect and identify compounds	Using ultraviolet l to detect and iden compounds	Lectures	Oral and written exam
4-8	14	2. Using infrared radiation to detect and identify compounds	Using infrared to de and identify vehicles Targeted medicat	Lectures	Oral and written exam
8-10	12	3. Using magnetic resonance imaging to detect and identify compounds 4. Using mass spectrometry to detect and identify compounds	Using magnetic resonance imagin detect and identif vehicles Using mass	Lectures	Oral and written exam

11-14	11	5. Elemental analysis	measurement to detect and identify compounds	Lectures	Oral and written exam
15	2		Element analysis	Lectures	Oral and written exam

59. Course Evaluation

Annual assessment: 30%, theoretical exam:
 *(25% midterm exam + 5% daily exams)
 Final exam: 70% theoretical only
 Final grade: 100%

60. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Spectrometric Identification of Organic Compounds Silverstein, Bassler and Morrill. Applications of absorption spectroscopy of organic compounds by Dyer JR. Organic Chemistry by McMurry; 5th ed; Thomson learning CA, USA 2000.
Main references (sources)	Spectrometric Identification of Organic Compounds by Silverstein, Bassler and Morrill. Applications of absorption spectroscopy of organic compounds by Dyer JR. Organic Chemistry by McMurry; 5th ed; Thomson learning CA, USA 2000.
Recommended books and references (scientific journals, reports...)	Organic Chemistry by McMurry; last edition.
Electronic References, Websites	

Course Description Form

1. Course Name:					
Advanced Pharmaceutical Analysis (Practical)					
2. Course Code:					
PHC 524					
3. Semester / Year:					
2 ^{ed} Semester / 5 th Year					
4. Description Preparation Date:					
2025					
5. Available Attendance Forms:					
In-person					
6. Number of Credit Hours (Total) / Number of Units (Total)					
30 hours (theoretical and practical) / 1 Units					
7. Course administrator's name (mention all, if more than one name)					
Name: Assistant Lecturer Hussein Nasser Email: Hussein.Naser@nahrainuniv.edu.iq					
8. Course Objectives					
Course Objectives			Advanced Pharmaceutical Analysis: Study of spectroscopic methods their use in identifying organic compounds.		
9. Teaching and Learning Strategies					
Strategy	1- Gaining skills in preparing compounds and medicines 2 - Gaining skills in using different methods in manufacturing and preparing medicines 4 - Gaining skills in handling chemical compounds 4 - Gaining skills in writing scientific reports and conducting scientific experiments 5 - Building student confidence through presenting scientific research 6 - Gaining skills in detecting, classifying, and evaluating medicines				
10. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2	Definition and application in the field of advanced pharmaceutical analysis	Introduction & demonstration of visible spectrophotometry	Practical	Oral and written exam
2	2		Absorption spectra of known colored solutions	Practical	Oral and written exam
3	2		Absorption spectra of unknown colored solutions	Practical	Oral and written exam
4	2		Beer's law plot of known solution.	Practical	Oral and written exam
5	2		Beer's law plot of known solution.	Practical	Oral and written exam
6	2		Beer's law plot of known solution.	Practical	Oral and written exam
7	2		Colorimetric assay	Practical	Oral and written exam

8	2		of tetracycline (FeCl ₃), known sample.	Practical	Oral and written exam
9	2			Practical	Oral and written exam
10	2		Colorimetric ass of tetracycline (FeCl ₃), unknown sample	Practical	Oral and written exam
11	2			Practical	Oral and written exam
12	2				Oral and written exam
13	2		Colorimetric ass of tetracycline (acid), known sample		
14	2				
15	2		Colorimetric ass of tetracycline (acid), unknown sample		
			Colorimetric ass of streptomycin (maltol, known sample).		
			Colorimetric ass of streptomycin (maltol, unknown sample)		
			Colorimetric ass of streptomycin (oxidized, known sample).		
			Colorimetric ass of streptomycin (oxidized, unknown sample).		
			Colorimetric ass of tetracycline (basic, known sample)		
			Colorimetric ass of tetracycline (basic unknown sample)		

11. Course Evaluation

The grade is distributed out of 20 based on the tasks assigned to the student, such as daily preparation, daily exams, oral and written exams, reports, etc.

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)

Spectrometric Identification of Organic Compounds
Silverstein, Bassler and Morrill.

Applications of absorption spectroscopy of organic compounds by Dyer JR.

	Organic Chemistry by McMurry; 5th ed; Thomson Learning CA, USA 2000.
Main references (sources)	<p>Spectrometric Identification of Organic Compounds by Silverstein, Bassler and Morrill.</p> <p>Applications of absorption spectroscopy of organic compounds by Dyer JR.</p> <p>Organic Chemistry by McMurry; 5th ed; Thomson Learning CA, USA 2000.</p>
Recommended books and references (scientific journals, reports...)	Organic Chemistry by McMurry; last edition.
Electronic References, Websites	

Course Description Form

13. Course Name:	
Advanced Analytical Chemistry	
14. Course Code:	
15. Semester / Year:	
1 st Semester / Master	
16. Description Preparation Date:	
2025	
17. Available Attendance Forms:	
In-person	
18. Number of Credit Hours (Total) / Number of Units (Total)	
30 hours (theoretical and practical) / 2 Units	
19. Course administrator's name (mention all, if more than one name)	
Name: Professor Dr. Mohammed Jassim Hamzah Email: dr.mohammed.jasim@nahrainuniv.edu.iq	
20. Course Objectives	
Course Objectives	1- Knowledge of automated analytical methods in pharmaceutical analysis. 2- Knowledge of how to develop analytical methods and study how to select the appropriate method. 3- Knowledge of the theoretical and scientific foundations of each analytical technique. 4- Knowledge of the quantitative and qualitative estimation of each chemical and pharmaceutical compound.
21. Teaching and Learning Strategies	
Strategy	1- Acquire skills in chemical and pharmaceutical analysis techniques. 2- A detailed explanation of each analytical method. 3- How to evaluate each analytical method. 4- Conduct a daily exam and discuss each analytical method. 5- Conduct a semester exam on all methods explained.

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22. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1,2,3	6	Basic concepts of the method of separating chemical and pharmaceutical compounds using liquid chromatography and understanding the theoretical foundations of this analytical method.	High performance liquid chromatography	Lectures	Midterm and daily exams and final assessment
4,5,6	6	Basic theoretical and practical concepts, separation method, and applications of gas chromatography	Gas chromatography	Lectures	Midterm and daily exams and final assessment
8-10	8	Understand the method of diagnosing pharmaceutical and chemical compounds using infrared spectroscopy, with an understanding of the theoretical foundations and practical applications of this method.	infrared spectroscopy	Lectures	Midterm and daily exams and final assessment
8-10	6	Basic theoretical and practical concepts of quantitative and qualitative analysis and diagnosis using UV-Vis spectroscopy	UV-Visible Spectroscopy	Lectures	Midterm and daily exams and final assessment
7,8,9,10	4	Basic concepts of quantitative analysis and theoretical foundations for the analysis and separation of pharmaceutical and chemical compounds using thin layer chromatography.	thin layer chromatography	Lectures	Midterm and daily exams and final assessment

23. Course Evaluation

Annual effort: 30%
 *(25% midterm exam + 5% daily exams)
 Final exam: 70% theoretical only
 Final grade: 100%

24. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Fundamentals of Analytical Chemistry (EIGHTH EDITION) Douglas A. Skoog Donald M. West F. James Holler Stanley R. Crouch Chemical Analysis Modern Instrumentation Methods and Techniques (Second Edition) Francis Rouessac and Annick Rouessac
Main references (sources)	<ul style="list-style-type: none"> Fundamentals of Analytical Chemistry (EIGHTH EDITION) Douglas A. Skoog Donald M. West F. James Holler Stanley R. Crouch

	<ul style="list-style-type: none"> Chemical Analysis Modern Instrumentation Methods and Techniques (Second Edition) Francis Rouessac and Annick Rouessac
Recommended books and references (scientific journals, reports...)	
Electro nic References, Websites	

Course Description Form

1. Course Name:	
Advanced Organic Chemistry	
2. Course Code:	
3. Semester / Year:	
2 ^{ed} Semester / Master	
4. Description Preparation Date:	
2025	
5. Available Attendance Forms:	
In-person	
6. Number of Credit Hours (Total) / Number of Units (Total)	
30 hours (theoretical and practical) / 2 Units	
7. Course administrator's name (mention all, if more than one name)	
Name: Professor Dr. Ahmed Thamer Email: dr.ahmad.thamer@nahrainuniv.edu.iq	
8. Course Objectives	
Course Objectives	1- Methods for preparing heterocyclic compounds 2- Knowing the nomenclature of heterocyclic compounds 3- Mechanisms for preparing heterocyclic compounds 4- Some cyclic compounds used in the pharmaceutical indust
9. Teaching and Learning Strategies	
Strategy	Lectures

Midterm Exam
Surprise Questions
Brainstorming
Final Exam

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2		Naming and preparing tricyclic rings		
2	2		Preparation mechanics		
3	2		Naming and preparing quadrilateral rings		
4	2		Preparation mechanics		
5	2		Naming and preparing pentagonal rings		
6	2		Preparation mechanics		
7	2		Naming and preparing hexagonal rings		
8	2		Preparation mechanics		
9	2		Aromatic cyclic compounds		

10	2		Naming aromatic rings		
11	2		Methods of preparing aromatic compounds		
12	2		Unsaturated compounds and their naming		
13	2		Preparation of unsaturated compounds		
14	2		Exam		
15	2		Final Exam		

11. Course Evaluation

Annual effort: 30%

*(25% midterm exam + 5% daily exams)

Final exam: 70% theoretical only

Final grade: 100%

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Chemistry of heterocyclic compounds Acheson or paket
Main references (sources)	Chemistry of heterocyclic compounds Acheson or paket
Recommended books and references (scientific journals, reports...)	
Electronic References, Websites	

Course Description Form

13.	Course Name:
	Lab Instrument Techniques
14.	Course Code:
15.	Semester / Year:
	2 ^{ed} Semester / Master
16.	Description Preparation Date:

2025					
17. Available Attendance Forms:					
In-person					
18. Number of Credit Hours (Total) / Number of Units (Total)					
30 hours (theoretical and practical) / 2 Units					
19. Course administrator's name (mention all, if more than one name)					
Name: Professor Dr. Mohammed Jassim Hamzah Email: dr.mohammed.jasim@nahrainuniv.edu.iq Name: Professor Dr. Rafal Shakib AbdelWahab Name: Professor Dr. Ahmed Thamer Email: dr.ahmad.thamer@nahrainuniv.edu.iq					
20. Course Objectives					
Course Objectives		1- Teaching students to the devices used to measure and analyze chemicals and drugs, such as spectrophotometers, infrared rays, and nuclear magnetic resonance. 2- Teaching and training students on some of the techniques used in laboratory testing, such as ELISA.			
21. Teaching and Learning Strategies					
Strategy	Teaching methods in the Lab instrument technique course focus on explaining topics in a detailed, interactive manner, including student assessment through daily and monthly tests as well as a final exam.				
22. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1,2	4		Magnetic resonance spectroscopy	Lectures	Midterm and daily exams and final assessment
3,4	4		Mass spectroscopy		
5,6,7	6		Atomic absorption spectroscopy	Lectures	Midterm and daily exams and final assessment Midterm and daily exams and final assessment

8,9,10	6		PH measurement	Lectures	
11,12,13	4		Thermal gravimetric analysis	Lectures	Midterm and daily exams and f assessment
14			The role of the enzyme-linked immunosorbent assay in detection	Lectures	Midterm and daily exams and f assessment
15			Exploring the role of conventional and real time PCR in modern pharmacy	Lectures	Midterm and daily exams and final assessment

23. Course Evaluation

Annual effort: 30%
 *(25% midterm exam + 5% daily exams)
 Final exam: 70% theoretical only
 Final grade: 100%

24. Learning and Teaching Resources

Required textbooks (curricular books, if any) Fundamentals of Analytical Chemistry Stook and West.

Main references (sources)

Spectrometric Identification of Organic Compounds by Silverstein, Bassler and Morrill.
 Tefvik Dorak M . Real – Time PCR. 1st Edition.© 2006 by Taylor & Francis Group. London .<https://www.gene-quantification.de/dorak-book-real-time-pcr-2006>.

Sakshi pandey. 2021. METHODS AND APPLICTION OF ELISA.times of agriculture.In .Issue 18.

Recommended books and references (scientific journals, reports...)	
Electronic References, Websites	