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Department: Chemistry	Program: Bachelor's Degree	Official Stamp
The study plan was approved by the decision of the Deans' Council no. ..... on		

Overview
Teaching began in the Chemistry Department in the academic year 1976/1977, at which time, graduating students were granted a Bachelor's degree in Chemistry. In view of the increasing need for postgraduate studies, the Master's program was created in the year 1982. Graduates receive a Master's degree in the disciplines of organic, inorganic, analytical and physical chemistry. The Chemistry Department building occupies an area of 4000 m^2, which includes 9 teaching laboratories, 15 research laboratories, 4 lecture halls, and offices for faculty members, lecturers, teaching assistants and technicians.

Vision and Mission	
Vision	That the Chemistry Department be outstanding and a pioneer in its undergraduate and Master's study plans, which must keep pace with the requirements of the modern era, as well as recruiting distinguished teaching and research faculty members to meet the needs of the community and the labor market with distinguished and well-qualified chemical expertise.
Mission	Preparing qualified graduates with knowledge and creativity in the field of chemistry who are able to interact with the requirements of the scientific and technological era and contribute to building the Jordanian society on sound scientific and ethical foundations.

Program Educational Objectives PEOs	
1	To provide the graduates with knowledge in all fields of chemistry and deepen their understanding of the methodology of analysis and criticism of scientific research and use these skills to explain scientific phenomena.
2	To provide the graduates with scientific and research skills that enable them to succeed in graduate programs and help them in their career, whether in teaching or other fields such as industry.
3	Training on a wide range of experimental techniques using modern scientific equipment.
4	Developing the skills of using modern research sources to enable students to build the necessary scientific skills such as scientific writing and the skill of discussion and constructive criticism and scientific communication skill.

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Program Learning Outcomes PLOs	
PLO1	An ability to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to the discipline.
PLO2	An ability to formulate or design a system, process, procedure or program to meet desired needs.
PLO3	An ability to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
PLO4	An ability to communicate effectively with a range of audiences.
PLO5	An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.
PLO6	An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

Learning Outcomes	Program Goals
(1) An ability to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to the discipline. **(2) An ability to formulate or design a system, process, procedure or program to meet desired needs.** **(3) An ability to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.** **(4) An ability to communicate effectively with a range of audiences.** **(5) An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.** **(6) An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.**	**1. To provide the graduates with knowledge in all fields of chemistry and deepen their understanding of the methodology of analysis and criticism of scientific research and use these skills to explain scientific phenomena.** **2. To provide the graduates with scientific and research skills that enable them to succeed in graduate programs and help them in their career, whether in teaching or other fields such as industry.** **3. Training on a wide range of experimental techniques using modern scientific equipment.** **4. Developing the skills of using modern research sources to enable students to build the necessary scientific skills such as scientific writing and the skill of discussion and constructive criticism and scientific communication skill.**

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Mapping educational outcomes

Learning Outcomes						
Course code and number	Ability to identify and solve problems by applying broad technical or scientific knowledge such as knowledge of mathematics and/or technical subjects and relating it to different fields. I	The ability to formulate or design the desired game system, method, procedure, or program required. II	The ability to develop and conduct experiments or test hypotheses, analyze them, interpret data, and use scientific reasoning to draw conclusions III	Ability to communicate effectively with the work team. IV	Ability to understand ethical and professional responsibilities and their impact on technical and/or scientific solutions in multiple global, economic, environmental and societal domains V	Ability to work effectively within a team that sets goals, plans tasks within specific deadlines, and analyzes potential risks to avoid them. VI
Chem. 101	√	√				
Chem. 102	√	√	√			
Chem. 107	√	√				
Chem. 108	√		√			
Chem. 211	√	√				
Chem. 212	√	√				
Chem. 213	√	√		√	√	√
Chem. 217	√		√		√	
Chem. 221	√		√			
Chem. 231	√	√	√			
Chem. 232	√		√			
Chem. 311	√	√				
Chem. 318	√		√			√
Chem. 321	√					
Chem. 323			√	√		
Chem. 331	√	√	√	√	√	√

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Learning Outcomes						
Course code and number	Ability to identify and solve problems by applying broad technical or scientific knowledge such as knowledge of mathematics and/or technical subjects and relating it to different fields.	The ability to formulate or design the desired game system, method, procedure, or program required.	The ability to develop and conduct experiments or test hypotheses, analyze them, interpret data, and use scientific reasoning to draw conclusions	Ability to communicate effectively with the work team.	Ability to understand ethical and professional responsibilities and their impact on technical and/or scientific solutions in multiple global, economic, environmental and societal domains	Ability to work effectively within a team that sets goals, plans tasks within specific deadlines, and analyzes potential risks to avoid them.
Chem. 334	√	√	√			
Chem. 341	√	√	√		√	
Chem. 342	√	√	√		√	
Chem. 345	√	√	√	√	√	√
Chem. 346	√	√	√	√	√	√
Chem. 351	√		√			
Chem. 411	√		√			
Chem. 412	√		√			
Chem. 413	√		√			
Chem. 414	√	√	√			√
Chem. 418	√	√	√			
Chem. 421	√	√		√		
Chem. 422	√	√	√			
Chem. 423	√		√			
Chem. 431		√	√			
Chem. 432	√	√	√			√
Chem. 442	√	√	√			
Chem. 451	√					
Chem. 452	√					
Chem. 453	√				√	

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Learning Outcomes						
Course code and number	**Ability to identify and solve problems by applying broad technical or scientific knowledge such as knowledge of mathematics and/or technical subjects and relating it to different fields.**	**The ability to formulate or design the desired game system, method, procedure, or program required.**	**The ability to develop and conduct experiments or test hypotheses, analyze them, interpret data, and use scientific reasoning to draw conclusions**	**Ability to communicate effectively with the work team.**	**Ability to understand ethical and professional responsibilities and their impact on technical and/or scientific solutions in multiple global, economic, environmental and societal domains**	**Ability to work effectively within a team that sets goals, plans tasks within specific deadlines, and analyzes potential risks to avoid them.**
Chem. 455	√				√	
Chem. 492	√				√	
Chem. 493	√	√			√	
Chem. 494	√			√	√	
Chem. 495	√		√		√	
Chem. 499	√				√	√

Compulsory basic scientific fields

Credit Hours	Course type	Course Name	Course Number	Compulsory fields
3	Theoretical	Basic Inorganic Chemistry	Chem. 221	Inorganic Chemistry Minimum Credit Hours (Hours 12)
3	Theoretical	Chemistry of Transition Metals	Chem. 321	
3	Theoretical	Organometallic Chemistry	Chem. 421	
3	Practical	Inorganic Chemistry Lab.	Chem. 323	
12	Practical		Theoretical	
3	Theoretical	Organic Chemistry (1)	Chem. 211	Organic - and Bio-chemistry Minimum Credit Hours (12 Hours)
3	Theoretical	Organic Chemistry (2)	Chem. 212	
3	Theoretical	Organic Chemistry (3)	Chem. 311	
2	Practical	Organic Chemistry Lab. (1)	Chem. 213	
3	Theoretical	Spectroscopic Identification of Organic Compounds	Chem. 217	
3	Theoretical	Organic Biochemistry	Chem. 418	
4	Practical	Advanced Synthesis and characterization of chemical compounds	Chem. 414	
21			Theoretical	
3	Theoretical	Physical Chemistry (1)	Chem. 341	Physical Chemistry Minimum Credit Hours (Hours 12)
3	Theoretical	Physical Chemistry (2)	Chem. 342	
3	Theoretical	Physical Chemistry (3)	Chem. 442	
2	Practical	Physical Chemistry Lab. (1)	Chem. 345	
2	Practical	Physical Chemistry Lab. (2)	Chem. 346	
13			Theoretical	
3	Theoretical	Analytical Chemistry (1)	Chem. 231	Analytical Chemistry Minimum Credit Hours (Hours 12)
3	Theoretical	Instrumental Analysis	Chem. 331	
3	Theoretical	Advanced Instrumental Analysis	Chem. 432	
1	Practical	Analytical Chemistry Lab.	Chem. 232	
2	Practical	Instrumental Analysis Lab.	Chem. 334	
12			Theoretical	
3	Theoretical	General Chemistry (1)	Chem. 101	General Chemistry
3	Theoretical	General Chemistry (2)	Chem. 102	
1	Practical	General Chemistry Lab.	Chem. 107	
0	Theoretical	Chemical Safety and Chemical Security	Chem. 108	
7			Theoretical	

Distribution of Credit Hours to Obtain a Bachelor's Degree in chemistry			
Requirement		**Total Credit Hours**	**Percentage from Total Credit Hours of Study Plan**
University Requirements	Mandatory	15	11.2%
	Elective	12	9%
Faculty Requirements	Mandatory	21	15.6 %
	Elective	-	-
Department Requirements	Mandatory	71	53 %
	Elective	15	11.2 %
Total		134	100%

1. University Mandatory Requirements (15 Credit Hours)			
Course Code	**Course Number**	**Course Name**	**Credit Hours**
HUM	117	Leadership and Innovation	1
HUM	118	Leadership and Social Responsibility	1
HUM	119	Life Skills	1
HUM	120	Communication Skills in English	3
HUM	121	Communication Skills in Arabic	3
HUM	124	National Education	3
MILT	100A	Military Sciences	3
EL	099	English Language - Remedial	0
AL	099	Arabic Language - Remedial	0
COMP	099	Computer skills - Remedial	0
SA	100	Ethics and Volunteer Work	0

2. University Elective Requirements (12 Credit Hours)

The students study one course (3 credit hours) from each of the following four packages, **OR** study (12 credit hours) for the same language from the languages courses package.

(1) Humanities Courses Package

Course Code	Course Number	Course Name	Credit Hours
HUM	101	Mass Communication Culture	3
HUM	104	Arts and behaviors	3
HUM	105	Jordan Contribution to the Human Civilization	3
HUM	106	Introduction to the Human cultural Studies	3
HUM	107	Human rights	3
HUM	109	Islamic Systems	3
HUM	110	The Culture of Tourism and Hospitality	3
HUM	113	Islamic Educational Thinking	3
HUM	115	Legal Education	3
HUM	123	Performing Arts	3

(2) Social and Economic Sciences Courses Package

Course Code	Course Number	Course Name	Credit Hours
HUM	102	Citizenship and Allegiance	3
HUM	103	Islamic Intellect and Civilization	3
HUM	108	Thinking Skills	3
HUM	111	History of Jerusalem	3
HUM	112	Geography of Jordan	3
HUM	114	Good governance and Integrity	3
HUM	116	Ancient Writings of Jordan	3
HUM	122	Economy and Society	3
SCI	103	Fitness for Everyone	3
SCI	104	Effective Communication Skills	3
SCI	106	Administration and Community Development	3

(3) Scientific and Technological Courses Package

Course Code	Course Number	Course Name	Credit Hours
SCI	101	Environment and Public Health	3
SCI	102	Information Technology and Society	3
SCI	105	Renewable Energy	3
SCI	107	Scientific Research	3
SCI	109	Digital Culture	3

SCI	110	Development and Environment	3
SCI	111	Principles of Epidemiology and Community Immunity	3

3. Faculty Mandatory Requirements (21 Credit Hours)

Course Code	Course Number	Course Name	Credit Hours			Pre-requisite
			Theoretical	Practical	Total	
MATH	101	Calculus (1)	3	-	3	-
PHYS	101	General Physics (1)	3	-	3	-
CHEM	101	General Chemistry (1)	3	-	3	-
BIO	101	General Biology (1)	3	-	3	-
STAT	101	Principles of statistics (1)	3	-	3	-
EES	101	General Geology (1)	3	-	3	-
CS	110	Programming in a Selected Language	3	-	3	-

4. Faculty Elective Requirements (0 Credit Hours)

Course Code	Course Number	Course Name	Credit Hours			Pre-requisite
			Theoretical	Practical	Total	

5. Department Compulsory Courses (71) Credit Hours						
Course Code	Course No.	Course Name	Number of Credit Hours			Pre-requisite
			Theoretical	Practical	Total	
CHEM	102	General Chemistry (2)	3	-	3	CHEM 101
CHEM	107	General Chemistry Lab.	-	3	1	CHEM 102 CHEM 103 or concurrently
Math	102	Calculus (2)	3	-	3	Math 101
Phys	102	General Physics (2)	3	-	3	Phys 101
CHEM	108	Chemical Safety and Chemical Security	1	-	-	
Math	206	Mathematics for Chemistry Students	3	-	3	Math 101 Math 102 or concurrently
CHEM	211	Organic Chemistry (1)	3	-	3	CHEM 102
CHEM	212	Organic Chemistry (2)	3	-	3	CHEM 107 CHEM 211
CHEM	213	Organic Chemistry Lab. (1)	1	3	2	CHEM 108 CHEM 212 or concurrently
CHEM	217	Spectroscopic Identification of Organic Compounds	3	-	3	CHEM 212 or concurrently
CHEM	221	Basic Inorganic Chemistry	3	-	3	CHEM 211 CHEM 215
CHEM	231	Analytical Chemistry (1)	3	-	3	CHEM 102 CHEM 107
CHEM	232	Analytical Chemistry Lab.	-	3	1	CHEM 108 CHEM 231 or concurrently
CHEM	311	Organic Chemistry (3)	3	-	3	CHEM 212
CHEM	321	Chemistry of Transition Metals	3	-	3	CHEM 212 CHEM 221
CHEM	323	Inorganic Chemistry Lab.	1	5	3	CHEM 321 or concurrently
CHEM	331	Instrumental Analysis	3	-	3	CHEM 231 CHEM 232
CHEM	334	Instrumental Analysis Lab.	1	3	2	CHEM 331 or concurrently
CHEM	341	Physical Chemistry (1)	3	-	3	CHEM 102 CHEM 107 & Math 206
CHEM	342	Physical Chemistry (2)	3	-	3	CHEM 341

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5. Department Compulsory Courses (71) Credit Hours						
Course Code	**Course No.**	**Course Name**	**Number of Credit Hours**			**Pre-requisite**
			Theoretical	**Practical**	**Total**	
CHEM	345	Physical Chemistry Lab. (1)	1	3	2	CHEM 342 or concurrently
CHEM	346	Physical Chemistry Lab. (2)	1	3	2	CHEM 342 CHEM 345
CHEM	414	Advanced Synthesis and characterization of chemical compounds	2	4	4	CHEM 217 CHEM 213 CHEM 311
CHEM	418	Organic Biochemistry	3	-	3	CHEM 311
CHEM	421	Organometallic Chemistry	3	-	3	CHEM 321
CHEM	432	Advanced Instrumental Analysis	3	-	3	CHEM 331 CHEM 334
CHEM	442	Physical Chemistry (3)	3	-	3	CHEM 342 CHEM 345

6. Department Elective Courses (15) Credit Hours

Course Code	Course No.	Course Name	Number of Credit Hours			Pre-requisite
			Theoretical	Practical	Total	
CHEM	351	Chemistry and Life	3	–	3	CHEM 212, CHEM 221
CHEM	411	Chemistry of Carbanions and Carbenes	3	–	3	CHEM 311
CHEM	412	Molecular Biology and Biochemistry	3	–	3	CHEM 104, CHEM 311
CHEM	413	Heterocyclic Chemistry	3	–	3	CHEM 311
CHEM	422	Descriptive Inorganic Chemistry of the Elements	3	–	3	CHEM 321
CHEM	423	Heterogeneous Catalysis	3	–	3	CHEM 321
CHEM	431	Chromatography and Mass Spectrometry	3	–	3	CHEM 331, CHEM 334
CHEM	451	Industrial Chemistry	3	–	3	CHEM 213, CHEM 341
CHEM	452	Computer Applications in Chemistry	3	–	3	Math 206, CHEM 342
CHEM	453	Environmental Chemistry	3	–	3	CHEM 221, CHEM 231
CHEM	455	Computational Chemistry	3	–	3	CHEM 442 or concurrently
CHEM	492	Special Topics in Inorganic Chemistry	3	–	3	CHEM 321
CHEM	493	Special Topics in Analytical Chemistry	3	–	3	CHEM 331
CHEM	494	Special Topics in Physical Chemistry	3	–	3	CHEM 342
CHEM	495	Special Topics in Organic Chemistry	3	–	3	CHEM 311
CHEM	499	Research	3	–	3	Department Approval

1.Single Major (for physics students who do not have a minor)

7. Specialization Compulsory Courses (71) Credit Hours

Course Code	Course No.	Course Name	Number of Credit Hours			Pre-requisite
			Theoretical	Practical	Total	
CHEM	102	General Chemistry (2)	3	-	3	CHEM 101
CHEM	107	General Chemistry Lab.	-	3	1	CHEM 102 CHEM 103 or concurrently
Math	102	Calculus (2)	3	-	3	Math 101
Phys	102	General Physics (2)	3	-	3	Phys 101
CHEM	108	Chemical Safety and Chemical Security	1	-	-	
Math	206	Mathematics for Chemistry Students	3	-	3	Math 101 Math 102 or concurrently
CHEM	211	Organic Chemistry (1)	3	-	3	CHEM 102
CHEM	212	Organic Chemistry (2)	3	-	3	CHEM 107 CHEM 211
CHEM	213	Organic Chemistry Lab. (1)	1	3	2	CHEM 108 CHEM 212 or concurrently
CHEM	217	Spectroscopic Identification of Organic Compounds	3	-	3	CHEM 212 or concurrently
CHEM	221	Basic Inorganic Chemistry	3	-	3	CHEM 211 CHEM 215
CHEM	231	Analytical Chemistry (1)	3	-	3	CHEM 102 CHEM 107
CHEM	232	Analytical Chemistry Lab.	-	3	1	CHEM 108 CHEM 231 or concurrently
CHEM	311	Organic Chemistry (3)	3	-	3	CHEM 212
CHEM	321	Chemistry of Transition Metals	3	-	3	CHEM 212 CHEM 221
CHEM	323	Inorganic Chemistry Lab.	1	5	3	CHEM 321 or concurrently
CHEM	331	Instrumental Analysis	3	-	3	CHEM 231 CHEM 232
CHEM	334	Instrumental Analysis Lab.	1	3	2	CHEM 331 or concurrently
CHEM	341	Physical Chemistry (1)	3	-	3	CHEM 102 CHEM 107 & Math 206

CHEM	342	Physical Chemistry (2)	3	-	3	CHEM 341
CHEM	345	Physical Chemistry Lab. (1)	1	3	2	CHEM 342 or concurrently
CHEM	346	Physical Chemistry Lab. (2)	1	3	2	CHEM 342 CHEM 345
CHEM	414	Advanced Synthesis and characterization of chemical compounds	2	4	4	CHEM 217 CHEM 213 CHEM 311
CHEM	418	Organic Biochemistry	3	-	3	CHEM 311
CHEM	421	Organometallic Chemistry	3	-	3	CHEM 321
CHEM	432	Advanced Instrumental Analysis	3	-	3	CHEM 331 CHEM 334
CHEM	442	Physical Chemistry (3)	3	-	3	CHEM 342 CHEM 345

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8. Department Elective Courses (15) Credit Hours						
Course Code	Course No.	Course Name	Number of Credit Hours			Pre-requisite
			Theoretical	Practical	Total	
CHEM	351	Chemistry and Life	3	–	3	CHEM 212, CHEM 221
CHEM	411	Chemistry of Carbanions and Carbenes	3	–	3	CHEM 311
CHEM	412	Molecular Biology and Biochemistry	3	–	3	CHEM 104, CHEM 311
CHEM	413	Heterocyclic Chemistry	3	–	3	CHEM 311
CHEM	422	Descriptive Inorganic Chemistry of the Elements	3	–	3	CHEM 321
CHEM	423	Heterogeneous Catalysis	3	–	3	CHEM 321
CHEM	431	Chromatography and Mass Spectrometry	3	–	3	CHEM 331, CHEM 334
CHEM	451	Industrial Chemistry	3	–	3	CHEM 213, CHEM 341
CHEM	452	Computer Applications in Chemistry	3	–	3	Math 206, CHEM 342
CHEM	453	Environmental Chemistry	3	–	3	CHEM 221, CHEM 231
CHEM	455	Computational Chemistry	3	–	3	CHEM 442 or concurrently
CHEM	492	Special Topics in Inorganic Chemistry	3	–	3	CHEM 321
CHEM	493	Special Topics in Analytical Chemistry	3	–	3	CHEM 331
CHEM	494	Special Topics in Physical Chemistry	3	–	3	CHEM 342
CHEM	495	Special Topics in Organic Chemistry	3	–	3	CHEM 311
CHEM	499	Research	3	–	3	Department Approval

- Applications that the Chemistry Department considers for the other department:

Pre-requisite	Credit hours	Number of Credit Hours		Course name	Number Course
		Theoretical	Practical		
Chem.101 أو SCC. 102 or concurrently	1	3	0	general chemistry (For Hijjawi students and life sciences students)	Chem. 105
SCC. 103 or concurrently	2	4	1	organic chemistry (For life sciences students and specialization students	Chem. 216

2.Major/minor major (for physics students who have a minor with the main major)

9. Compulsory department requirements: (65) credit hours						
Pre-requisite	Number of Credit Hours			Course Code	Course No.	Course Name
	Total	Total	Total			
MATH 101	3	-	3	Calculus (2)	102	MATH
PHYS 101	3	-	3	General Physics (2)	102	PHYS
Chem. 101	3	-	3	General Chemistry (2)	102	CHEM
Chem. 102 or concurrently or Chem. 103 concurrently	1	3	-	General Chemistry Lab.	107	CHEM
-	0	-	1	Chemical Safety and Chemical Security	108	CHEM
MATH 101, MATH 102	3	-	3	Mathematics for Chemistry Students	206	MATH
Chem. 102	3	-	3	Organic Chemistry (1)	211	CHEM
Chem. 107 & Chem. 211	3	-	3	Organic Chemistry (2)	212	CHEM
or Chem. 212 concurrently Chem.108	2	3	1	Organic Chemistry Lab. (1)	213	CHEM
Chem. 212 or concurrently	3	0	3	Spectroscopic Identification of Organic Compounds	217	CHEM
Chem. 211 او Chem. 215	3	-	3	Basic Inorganic Chemistry	221	CHEM
Chem. 102 & Chem. 107	3	-	3	Analytical Chemistry (1)	231	CHEM
Chem.108 أو Chem. 231	1	3	-	Analytical Chemistry Lab.	232	CHEM
Chem. 212	3	-	3	Organic Chemistry (3)	311	CHEM

9. Compulsory department requirements: (65) credit hours						
Pre-requisite	Number of Credit Hours			Course Code	Course No.	Course Name
	Total	Total	Total			
Chem. 212 & Chem. 221	3	-	3	Chemistry of Transition Metals	321	CHEM
Chem. 321	3	5	1	Inorganic Chemistry Lab.	323	CHEM
Chem. 231 & Chem. 232	3	-	3	Instrumental Analysis	331	CHEM
CHEM 331 or concurrently	2	3	1	Instrumental Analysis Lab.	334	CHEM
CHEM 331 or concurrently	3	-	3	Physical Chemistry (1)	341	CHEM
CHEM 102 CHEM 107 & Math 206	3	-	3	Physical Chemistry (2)	342	CHEM
CHEM 341	2	3	1	Physical Chemistry Lab. (1)	345	CHEM
CHEM 342 or concurrently	2	3	1	Physical Chemistry Lab. (2)	346	CHEM
CHEM 217 CHEM 213 CHEM 311	4	4	2	Advanced Synthesis and characterization of chemical compounds	414	CHEM
CHEM 331 CHEM 334	3	-	3	Advanced Instrumental Analysis	432	CHEM
CHEM 342 CHEM 345	3	-	3	Physical Chemistry (3)	442	CHEM

10. Department Elective Requirements (0 Credit Hours)						
Course Code	Course Number	Course Name	Credit Hours			Pre-requisite
			Theoretical	Practical	Total	

- Major/minor major (21 Credit Hours)
- Minor for the departments of the science College and the College of Information Technology and Computer Science (for student from other majors who want to have a minor in chemistry)

11. Compulsory department requirements: (14) credit hours						
Pre-requisite	Credit Hours			Course Name	Course Number	Course Code
	Total	Practical	Theoretical			
CHEM 101	3	-	3	General Chemistry (2)	102	CHEM
CHEM 102	1	3	-	General Chemistry Lab.	107	CHEM
CHEM 102	3	-	3	Organic Chemistry (1)	211	CHEM
CHEM 211	3	-	3	Basic Inorganic Chemistry	221	CHEM
CHEM 102 CHEM 107	3	-	3	Chemistry of Transition Metals	231	CHEM
CHEM 102, CHEM 107	1	3	-	Analytical Chemistry Lab.	232	CHEM

12. Department Elective Courses (7) Credit Hours						
Pre-requisite	Credit Hours			Course Name	Course Number	Course Code
	Total	Practical	Theoretical			
CHEM 211	2	3	1	organic chemistry	216	CHEM
CHEM 221	3	-	3	Chemistry of Transition Metals	321	CHEM
CHEM 231	3	-	3	Instrumental Analysis	331	CHEM
CHEM 331	3	-	3	Instrumental Analysis Lab.	334	CHEM
CHEM 102+CHEM 107 +CHEM 206	3	-	3	Physical Chemistry (1)	341	CHEM
CHEM 341	3	-	3	Physical Chemistry (2)	342	CHEM
CHEM 221	3	-	3	Chemistry and Life	351	CHEM
CHEM 221+CHEM 231	3	-	3	Environmental Chemistry	453	CHEM
CHEM 331 or CHEM 334	3	-	3	Advanced Instrumental Analysis	432	CHEM
CHEM 342	3	-	3	Computational Chemistry	455	CHEM

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Advisory Plan

First Academic Year – First Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
-	3	Calculus (1)	Math 101
-	3	General Physics (1)	Phys 101
-	3	Principles of statistics (1)	STAT 101
-	3	General Chemistry (1)	CHEM 101
-	0	Chemical Safety and Chemical Security	CHEM 108
	3		University Elective
hours 15		TOTAL	

First Academic Year – Second Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
Math 101	3	Calculus (2)	Math 102
Phys 101	3	General Physics (2)	Phys 102
CHEM 101	3	General Chemistry (2)	CHEM 102
CHEM 102 SCC 101	1	General Chemistry Lab.	CHEM 107
	3		University Elective
	3		University Req.
hours 16		TOTAL	

Second Academic Year – First Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
	3	Mathematics for Chemistry Students	Math 206
CHEM 102	3	Organic Chemistry (1)	CHEM 211
CHEM 102 CHEM 107	3	Analytical Chemistry (1)	CHEM 231
CHEM 108 CHEM 231	1	Analytical Chemistry Lab.	CHEM 232
	3		University Req.
	3		University Elective
hours 16		TOTAL	

Second Academic Year – Second Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
CHEM 107 CHEM 211	3	Organic Chemistry (2)	CHEM 212
CHEM 108 CHEM 212	2	Organic Chemistry Lab. (1)	CHEM 213
CHEM 211 SCC 103	3	Basic Inorganic Chemistry	CHEM 221
	3	General Geology (1)	EES 101
	3		University Req.
	3		University Elective
hours 17		TOTAL	

Third Academic Year – First Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
CHEM 212	3	Organic Chemistry (3)	CHEM 311
CHEM 212 CHEM 221	3	Chemistry of Transition Metals	CHEM 321
CHEM 212	3	Spectroscopic Identification of Organic Compounds	CHEM 217
CHEM 102 CHEM 107 Math 206	3	Physical Chemistry (1)	CHEM 341
	3	General Biology (1)	Bio. 101
	3		University Req.
hours 18		TOTAL	

Third Academic Year – Second Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
	3	Programming in a Selected Language	CS 101
CHEM 321	3	Inorganic Chemistry Lab.	CHEM 323
CHEM 231 CHEM 232	3	Instrumental Analysis	CHEM 331
CHEM 331	2	Instrumental Analysis Lab.	CHEM 334
CHEM 341	3	Physical Chemistry (2)	CHEM 342
CHEM 213 CHEM 217	4	Advanced Synthesis and characterization of chemical compounds	CHEM 414
	3		University Req.
hours 18		TOTAL	

Fourth Academic Year – First Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
CHEM 342 CHEM 345	3	Physical Chemistry (3)	CHEM 442
CHEM 342	2	Physical Chemistry Lab. (1)	CHEM 345
CHEM 311	3	Biochemistry	CHEM 418
CHEM 321	3	Organometallic Chemistry	CHEM 421
	3		متطلب قسم اختياري
	3		متطلب قسم اختياري
hours 17		TOTAL	

Fourth Academic Year – Second Semester

Pre-requisite	Credit Hours	Course Name	Code and Number
CHEM 342 CHEM 345	2	Physical Chemistry Lab. (2)	CHEM 346
CHEM 331 CHEM 334	3	Advanced Instrumental Analysis	CHEM 432
	3	Principles of statistics (1)	Stat. 101
	3		متطلب قسم اختياري
	3		متطلب قسم اختياري
	3		متطلب قسم اختياري
hours 17		TOTAL	

Document Code	Study Plan	Document Approval Date
AP02-PR04		

Department: Chemistry	Program: Bachelor's	Official Stamp:
The courses description was approved by the decision of the Department's Council no. ..... on		

Course Name: General Chemistry (1)	Course Code and Number: CHEM 101	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite:		
Course Description	The objective of this course is to provide a broad foundation in chemistry, including the following topics: Chemistry and measurement, stoichiometry, Thermochemistry, properties of solutions, atomic structure, periodic table and electronic configurations, molecular structure, chemical bonding, molecular shapes, gases. Learning outcomes, the students will: 1. Demonstrate the understanding of atomic structure and electronic configurations of atoms and ions. 2. Develop the ability to do stoichiometric calculations for chemical reactions. 3. Understanding the importance of the periodic table of elements, how it came to be, and its role in organizing chemical information	

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Course Name: General Chemistry (2)	Course Code and Number: CHEM 102	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 101		
Course Description	The objective of this course is to provide the students with the basic concepts of chemical equilibrium and chemical kinetics, including the following topics: Physical properties of solutions; chemical kinetics; chemical equilibrium; chemical thermodynamics; acid-base equilibria in aqueous solutions; solubility and complex ion equilibria; introduction into electrochemistry. Learning outcomes, the students will: 1. Demonstrate the understanding of physical properties of solutions. 2. Understand the concept of energy changes associated with chemical reactions and their kinetics. 3. Demonstrate a comprehensive understanding of chemical equilibrium and electrochemistry.	

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Course Name: Experimental General Chemistry	Course Code and Number: CHEM 105	Number of Credit Hours: 1
Teaching Language: English		
Pre-requisite:		
Course Description	**(For Non Chemistry Majors)** The course includes experiments dealing with the following topics: Lab. safety and basic Lab. techniques, formula of hydrate, empirical formula of a compound, limiting reactant, periodic chart and periodic law, spectroscopy and molecular geometry, properties of inorganic compounds and metathesis reactions, molecular weight of a volatile liquid, preparation of an alum, aspirin synthesis, standardization of NaOH solution and equivalent weight of an acid, bleach analysis. Learning outcomes, the students will: 1. Understand and comply with safety regulations as well as the ethics of working in chemical laboratories. 2. Ability to understand properties of chemical compounds and to perform accurate quantitative measurements and determination of molar masses of unknown substances and chemical formulae. 3. Synthesis of chemical compounds	

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Course Name: Experimental General Chemistry	Course Code and Number: CHEM 107	Number of Credit Hours: 1
Teaching Language: English		
Pre-requisite: CHEM 102, CHEM 103		
Course Description	The course includes experiments dealing with the following topics : safety and laboratory rules; preparation of an alum, limiting reactant, formula of hydrate, empirical formula of a compound, spectroscopy and molecular geometry, Aspirin synthesis, metathesis reactions, molecular weight of a volatile liquid, standardization of NaOH solution and equivalent weight of an acid, colligative properties (FW Determination), calorimetry, determination of a rate law, spectrophotometric determination of an equilibrium constant, equilibrium constant for a slightly soluble salt, solubility product constant and common-ion effect, oxidation and reduction reactions, activity series of some metals, pH, qualitative analysis: common anions, group I cations, group II cations, group III cations and general unknown. Learning outcomes, the students will: 1. Understand and comply with safety regulations as well as the ethics of working in chemical laboratories. 2. Demonstrate the ability to use basic chemical laboratories tools, perform accurate quantitative measurements and determine the chemical formula of a simple compound. 3. Ability to understand the properties of chemical compounds and to perform qualitative analysis.	

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Course Name: Chemical Safety and Chemical Security	Course Code and Number: CHEM 108	Number of Credit Hours: 0
Teaching Language: English		
Pre-requisite:		
Course Description	This course is designed to understand the best practices for handling chemicals and chemistry processes to minimize risk, whether to person, facility, or community. It involves understanding the physical, chemical, and toxicological hazards of chemicals. It also involves the understanding of preventing illegal or antisocial use of chemicals. Learning outcomes, the students will: 1. Identify and classify a hazardous chemical's class and type. 2. Demonstrate ways to assess and manage the hazards associated with chemicals. 3. Have an understanding of chemical safety concept. 4. Implement the proper procedures for responding to spills, emergencies, or injuries. 5. Have an understanding of chemical inventory. Ability to understand the properties of chemical compounds and to perform qualitative analysis	

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Course Name: Organic Chemistry (1)	Course Code and Number: CHEM 211	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 102		
Course Description	This course aims to give the students the initial knowledge of the principles of organic chemistry. The course covers the following topics: Bonding, molecular properties and structure of organic compounds, nomenclature, preparations, physical properties, stereochemistry, reactions and reaction mechanisms of alkanes, alkenes, alkynes and aromatic compounds. Learning outcomes, the students will: 1. Understanding the bonding, properties and chemical structure of organic compounds. 2. Identifying the different functional groups in organic chemistry. 3. Linking the concepts of the principles of general chemistry with themes of organic chemistry.	

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Course Name: Organic Chemistry (2)	Course Code and Number: CHEM 212	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 107, CHEM 211		
Course Description	The course aims at teaching the student the structure of organic compounds and the reactions of different functional groups. The course covers the following topics : Structures, nomenclature, preparations, physical properties, reactions and reaction mechanisms of alkyl halides, alcohols, phenols, ethers, sulfur compounds, aldehydes, ketones, carboxylic acids and their derivatives, amines and aryl amines. It also covers the carbonyl alpha substitution as well as condensation reactions Learning outcomes, the students will: 1. Understanding the nature and importance of carbonyl α-substitution and condensation reactions 2. Knowing the chemistry of several functional groups such as alcohols, ketones and aldehydes, carboxylic acids and their derivatives, amines and phenols. 3. Using the principles of physical chemistry in the study of the properties of organic compounds.	

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Course Name: Organic Chemistry Lab (1)	Course Code and Number: CHEM 213	Number of Credit Hours: 2
Teaching Language: English		
Pre-requisite: CHEM 108, CHEM 212		
Course Description	The course aims to give the student the basic techniques in the separation and identification of organic compounds. Course topics: Melting point, simple and Fractional distillation, crystallization, extraction, steam distillation, chromatography, molecular models, preparation of alkenes, reactions of alkanes, alkene and aromatics, alcohols, aldehydes and ketones, preparation of adipic and benzoic acid. Learning outcomes, the students will: 1. Employing the concentps of the principles of organic chemistry in the laboratory work. 2. The use of separation and purification of organic compounds techniques. 3. Preparation and identification of some simple organic compounds.	

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Course Name: Practical Organic Chemistry	Course Code and Number: CHEM 216	Number of Credit Hours: 2
Teaching Language: English		
Pre-requisite:		
Course Description	**(for non-majors)** The course aims to give students the skills of the initial laboratory work in organic chemistry for non-Chemistry students. - Melting points - Simple and fractional distillation - Crystallization - Steam distillation - Extraction and drying agents - Reactions of alkanes, alkenes and aromatic compounds - Reactions of aldehydes and ketones - Chemistry of alcohols - Nucleophilic substitution reactions - Stereochemistry - Carbohydrates - Soup Learning outcomes, the students will: - Enhance the student's ability to separate and purify organic compounds. - The ability to identify simple organic compounds. - Enhance the student's ability to prepare some organic compounds with different functional groups	

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Course Name: Spectroscopic Identification of Organic Compounds	Course Code and Number: CHEM 217	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 212 or concurrently		
Course Description	This course aims at giving deep knowledge in organic spectroscopy. Topics include mass spectrometry; ultraviolet-visible, infrared, and nuclear magnetic resonance spectroscopy and their uses in structure determination of organic molecules. Learning outcomes, the students will: 1. have achieved advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy ((UV-Vis, IR, NMR and Mass Spectroscopy). 2. be able to analyze and interpret spectroscopic data collected by the methods discussed in the course. 3. be able to solve problems related to the structure of chemicals and to study molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data	

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Course Name: Basic Inorganic Chemistry	Course Code and Number: CHEM 221	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 211, CHEM 215		
Course Description	This course aims at introducing the main concepts of inorganic chemistry to the students through expanding the knowledge gained from general chemistry courses. Course Topics are: Atomic structure, periodic table, valence bond theory, the use of hybridization concept to explain molecular properties, symmetry, molecular orbital theory for simple compounds, donor- acceptor concept, crystal structure of some compounds, descriptive chemistry of main- group elements. Learning outcomes, the students will: 1. Understanding atomic structure of the elements. 2. Understanding the periodic table and the periodicity of the elements. 3. Understanding the main ideas of chemical bonding theories such as, V.B. T, Hybridization, and M. O. T	

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Course Name: Analytical Chemistry	Course Code and Number: CHEM 231	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 102, CHEM 107		
Course Description	The objectives of this course are to provide the students with the knowledge of basic skills in analytical chemistry. These skills include the understanding and use of different chemical equilibrium systems. Also to analyze and determine the amount of a species by using the simple techniques in analytical chemistry such as precipitation, titration, Redox techniques. Electrochemical systems will also be learned through introduction electrochemical cells and electrode potentials. Chemical measurements will be evaluated through several statistical tools. Learning outcomes, the students will: 1. The distinction between the general types of analysis (qualitative and quantitative). 2. The application of statistical methods for analytical data. 3. The use of chemical equilibrium principles in quantitative analyses. 4. The precipitation and complexation principles in chemical analysis.	

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Course Name: Analytical Chemistry Laboratory	Course Code and Number: CHEM 232	Number of Credit Hours: 1
Teaching Language: English		
Pre-requisite: CHEM 108, CHEM 231		
Course Description	The objective of this laboratory is to provide the students with sills and simple techniques used in chemical analysis including: - Acid–base titrations (determination of carbonate, determination of antiacid in antiacidity drugs). Precipitation titrations (determination of chloride using Moher's method, determination of silver using Volhardo's method). Complexometric titrations (water hardness, determination of chloride in urine) Redox titrations (determination of hydrogen peroxide in some commercial products, determination of Vitamin C in juice, determination of Iron in some commercial products). Spectrophotometric determination of Aspirin and solubility product for some compounds. Learning outcomes, the students will: 1. The principles of several titrimetric systems such as (acid base, precipitation, complexometric and redox titrations) 2. The principles of spectrophotometric analysis.	

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Course Name: Organic Chemistry (3)	Course Code and Number: CHEM 311	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 212		
Course Description	This course demonstrates an understanding of basic principles of Polymer chemistry, Dienes, carbohydrates, amino acids, lipids and selected biologically important compounds. It also provides the basic knowledge of aromatic heterocycles, pericyclic reactions. It also makes connection from chemical principles to the structures and functions of biological molecules. Demonstrate an understanding of the chemical environment and the role that organic molecules play in the natural and the synthetic medicinal drugs and the Chemistry of Phosphorus and sulfur organic compounds. Learning outcomes, the students will: 1. Comprehend the fundamentals of organic chemistry of aromatic heterocyclic compounds [2. Understand the fundamentals of pericyclic reactions. 3. Understand the fundamentals Polymer chemistry. 4. Understand how chemistry is related to biological systems. Understand the chemistry of Phosphorus and sulfur organic compounds	

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Course Name: Chemistry of Transition Metals	Course Code and Number: CHEM 321	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 212, CHEM 221		
Course Description	This course introduces inorganic chemistry of the transition metals to the students. The main topics are : Electronic structure and general properties of transition elements. Transition elements. Transition metal complexes which include types of ligands and nomenclature, isomers and structures. Theories of bonding and magnetic properties. Electronic spectra. Substitution reaction. An introduction to organometallic compounds: the 18- and 16-electron rules. Learning outcomes, the students will: 1. Understand the general properties and electronic structure of transition metals. 2. Understand complexes of transition metals, their isomers, structures, bonding, magnetic and spectral properties. 3. Know the main differences between coordination and organometallic complexes.	

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Course Name: Practical Inorganic Chemistry	Course Code and Number: CHEM 323	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 321 or concurrently		
Course Description	This course involves the preparation and characterization of inorganic complexes of some non-transition and mainly transition metals. The main experiments are : Preparation of aluminum and manganese complexes with oxalate and acetylacetonate anions. Preparation of some cobalt complexes for the measurements of optical activity and conductivity. Separation of chromium complexes using ion exchange chromatography and then measurements of their UV-visible spectra. Preparation of a copper complex with thiourea then measuring its IR spectrum and doing copper analysis. Preparation of nickel bromo complex and measurements of its magnetic properties. Preparation of linkage isomers of cobalt with nitro- and nitrito- ligands and running IR spectra. Outcome results of this course are: Know the various techniques for the preparation of complexes, their purification and characterization techniques.	

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Course Name: Introduction to Instrumental Analysis	Course Code and Number: CHEM 331	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 231, CHEM 232		
Course Description	The objective of this course is to obtain a sound understanding of fundamental principles of instrumental methods of chemical analysis. These methods include: electromagnetic radiations and their interaction with matter, atomic and molecular spectroscopic methods, absorption and emission spectroscopy, Gas and liquid chromatography. The course will also cover some electroanalytical methods such as potentiometry, coulometry and voltammetry. On the other hand a special concentration will be given to understand the basic components and functions of some major analytical instruments used in the above methods. Learning outcomes, the students will: 1. The nature of light and the light-matter interactions. 2. The requirements, procedures and difficulties involved in different chemical analysis techniques (spectroscopic, chromatographic and electrochemical). 3. The principles of the atomic spectroscopy and it's applications. 4. The principles and applications of molecular spectroscopy. 5. The principles and applications of chromatographic methods (gas and liquid chromatography)	

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Course Name: Introduction to Instrumental Analysis Laboratory	**Course Code and Number: CHEM 334**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: CHEM 331 or concurrently		
Course Description	The objective of this laboratory course is to expose the students to several chemical analysis instruments ranging from spectroscopic (spectrophotometry, atomic absorption, atomic emission and fluorescence) to chromatographic (gas, liquid chromatography and to column chromatography) in addition to electrochemical methods (ion selective electrodes and potentiometric titrations). Learning outcomes, the students will: 1. Successfully utilize analytical chemical instrumentation properly including: preparation of high accuracy standards, set the operating parameters of different instruments, and perform correct analysis using different instruments. 2. The analysis of data using a spreadsheet program such as Excel. 3. Realize the existence of a variety of analytical methods, each with its own particular capabilities and limitations	

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Course Name: Physical Chemistry (1)	Course Code and Number: CHEM 341	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 102, CHEM 107 and Math 206		
Course Description	The course aims at introducing students to the principles of physical chemistry and linking concepts with what has been studied in the preparatory courses. Course topics are: Empirical properties of gases and the ideal gas law, real gases, the structure of gases (kinetic theory of gases), properties of liquids and solids, the zeroth law of thermodynamics, energy and the first law of thermodynamics; thermochemistry, the second law of thermodynamics, entropy and the third law of thermodynamics, spontaneity and equilibrium, chemical equilibrium, colligative properties, phase equilibria in simple systems and the phase rule. Learning outcomes, the students will: 1. Apply the basic concepts of calculus to concepts in chemistry. 2. Manipulate the gas laws to describe real and ideal gas behavior. 3. Discuss the Four Laws of Thermodynamics and their development. 4. Use the Maxwell equations and other thermodynamic relations to compute thermodynamic quantities from thermodynamic data tables. 5. Be able to derive relationships between thermodynamic quantities. 6. Be able to describe the properties of mixtures using thermodynamic properties. 7. Explain the origin of equilibrium constant and its relation to activity; apply these concepts to ideal and real solutions of electrolytes and non-electrolytes and to colligative properties. 8. Interpret phase diagrams of single component and binary systems and discuss phase equilibria in terms of chemical potential. 9. Have good skills in graph and data processing.	

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Course Name: Physical Chemistry (2)	Course Code and Number: CHEM 342	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 341		
Course Description	The course aims at expanding the student knowledge in physical chemistry. Course topics are: Electrolytic solutions, theories of strong and weak electrolytes, thermodynamics of solutions, equilibrium in electrochemical cells, chemical kinetics: empirical laws and mechanism, activation energy, collision theory, the transition state theory, Gibbs energy and entropy of activation, heterogeneous reactions, reversible, parallel and consecutive reactions, complex reactions. Knowledge: Thermodynamic description of ionic solutions and electrochemical systems as well as the kinetic description of temporal changes in chemical processes with applications in industry and life. Learning outcomes, the students will: 1. Describe interionic interaction in solutions and provide a physical basis for the Debye-Hückel theory. 2. Apply the principles of electrochemistry to voltaic and electrolytic systems and relate that to problems of electricity production and storage. 3. Explain how chemical reactions occur and how their rate is affected by reactant concentration, temperature, ionic strength and solvent effects. 4. Determine the rate law and the activation energy based on kinetic information. 5. Derive rate equations for complex processes including reversible, parallel and consecutive reactions as well as combinations of these processes. 6. List the methods for arriving at a plausible mechanism.	

	7. Explain the basic principles of chain and photochemical reactions. 8. Have good skills in graph and data processing.

Course Name: Physical Chemistry Lab (1)	Course Code and Number: CHEM 345	Number of Credit Hours: 2
Teaching Language: English		
Pre-requisite: CHEM 342 or concurrently		

Course Description	This course gives the student the opportunity to study the principles of Physical Chemistry in an experimental context with emphasis on chemical thermodynamics. Course Outlines: Heat of combustion, heat of solution of an inorganic compound, boiling point elevation, effect of pressure on boiling point, acid constant determination of methyl red, determination of standard potential of Zn/Zn^{2+} and Cu/Cu^{2+} electrodes, thermodynamic description of Daniel cell (temperature effect), partial molar volumes in aqueous NaCl solution, the phase diagram of a ternary system, effect of ionic strength on solubility, equilibrium constant determination of I_2/I^- system in aqueous solution, steam distillation, liquid-vapor phase diagram determination of a binary system. KNOWLEDGE : Basic physical chemistry concepts in chemical thermodynamics placed in experimental context. Learning outcomes, the students will: 1. To observe experiments, keep records of the observations made and analyze the data critically. 2. To report experimental results in a comprehensive scientific style. 3. To use a wide variety of analytical instrumentation. 4. To appreciate of the limitations of the methods

	employed by the use of error analysis. 5. To comply with safety requirements. 6. Have good skills in graph and data processing.

Course Name: Physical Chemistry Lab (2)	Course Code and Number: CHEM 346	Number of Credit Hours: 2
Teaching Language: English		
Pre-requisite: CHEM 342, CHEM 345		

Course Description	This course gives the student the opportunity to study the principles of various subjects in Physical Chemistry (Kinetics, Electrochemistry, Solution Chemistry and Spectroscopy) in an experimental context. Course outlines: Kinetics of ethyl acetate hydrolysis investigated by conductivity measurements, kinetics of the reaction of persulfate with iodide, analysis of the IR spectrum of HCl, analysis of visible spectrum of iodine vapor, determination of molar conductivity at infinite dilution of strong electrolytes (HCl, KCl, K-acetate), determination of acid constant of acetic acid through conductivity measurements, adsorption of acetic acid on activated charcoal from aqueous solutions, surface tension of various solutions, photochemical decomposition of benzenediazonium ion, aggregation of colloidal particles studied by conductivity measurements. Knowledge: Basic physical chemistry concepts in physical chemistry placed in experimental context. Learning outcomes, the students will: 1. To observe experiments, keep records of the observations made and analyze the data critically. 2. To report experimental results in a comprehensive scientific style. 3. To use a wide variety of analytical instrumentation.

	4. To appreciate of the limitations of the methods employed by the use of error analysis. 5. To comply with safety requirements. 6. Have good skills in graph and data processing.		
Course Name: Chemistry and Life		**Course Code and Number: CHEM 351**	**Number of Credit Hours: 3**
Teaching Language: English			
Pre-requisite: CHEM 212, CHEM 221			
Course Description	This course shows the importance of chemistry in our life. Its covers the following topics : Green Chemistry : its principles and % atom economy. Chemistry in Everyday life : drugs like antacids, antihistamines, tranquilizers, analgesics, antibiotic antiseptics and disinfectants. Chemical in food line artificial sweetening agents, coloures, flavours and preservatives. Petrochemicals : fertilizers, wax, detergents, dyes, polymers and pesticides. Purification and contamibation of water. Importance of elements in life. Learning outcomes, the students will: Understand the importance of chemical elements and compounds in various aspects of life such as medications, plastics, fertilizers, detergents and so on.		

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Course Name: Chemistry of Carbanions and Carbens	Course Code and Number: CHEM 411	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 311		
Course Description	This course aims at giving deep knowledge in organic chemistry (Carbanions and Carbenes). Topics include definition, structure and stability of carbanions, general methods for preparation of carbanions, general reaction types of carbanions, preparation and reactions of alkyl carbanions, preparation and reactions of carbanions stabilized by α-heteroatom, preparation and reaction of carbanions stabilized by Π conjugation with one heteroatom, preparation and reactions of carbanions stabilized by Π conjugation with two heteroatoms, Molecular rearrangements, introduction to the synthon approach. Learning outcomes, the students will: 1. To know the construction of the so-called "carbanions" and methods of preparation and structure determination 2. To know the types of reactions of carbanions 3. To know the reactions of the carbanions with the presence of hetroatoms and different bonds.	

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Course Name: Molecular Biology and Biochemistry	Course Code and Number: CHEM 412	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 104, CHEM 311		
Course Description	This course aims to cover essential aspects of biochemistry and molecular biology. Topics include the chemical foundations of life; the structure and function of biological molecules; list of biotechnology tools and genetic Engineering; gene expression-transcription, translation, and regulation; biomembranes and transmembrane transport; metabolism and cellular energetics; and signal transduction; RNA classifications and biosynthesis Learning outcomes, the students will: 1. Student will study biological techniques and methods that are needed in bioinformatics 2. Understand thermodynamics, reactions, pathways and enzymes regulation of metabolism. 3. Understand central dogma, amino acid classification, gene structure, RNA classifications and biosynthesis, and protein structure. 4. Understand some of biotechnology tools such as restriction endonucleases, nucleic acid technology, vectors, recombinant DNA, PCR, genetic engineering, and basic sequencing techniques. 5. Understand gene expression-transcription, translation, post-transcription and posttranslational modifications, and regulations. 6. Understand the difference between biomembranes and transmembrane transport and the concepts of the metabolism،signal transduction ،and cellular energetics	

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Course Name: Heterocyclic Chemistry	**Course Code and Number: CHEM 413**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: CHEM 311		
Course Description	This course aims at giving deep knowledge in organic chemistry (Heterocyclic Chemistry). Topics include Introduction, nomenclature, synthesis, reactions, and reaction mechanisms of three-, four-, five- and six- membered rings with one and more heteroatom and polynuclear heterocyclic compounds. Learning outcomes, the students will: 1. Understanding the naming rules for Heterocyclic compounds in general 2. Understanding of the properties of heterocyclic compounds 3. To know the methods for preparation and reactions of these compounds	

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Course Name: Advanced Synthesis and characterization of chemical compounds	**Course Code and Number: CHEM 414**	**Number of Credit Hours: 4**
Teaching Language: English		
Pre-requisite: :CHEM 217, CHEM 213,CHEM 311		
Course Description	The course aims to enable the student to apply the principles of preparing and diagnosing chemical compounds practically and to provide the student with the skill of conducting the basic reactions to prepare and diagnose various chemical compounds. **The course topics are:** Preparation of triphenylcarbinol, preparation of pinacol hydrate, rearrangement of pinacol to pinacolone and preparation of trimethyl acetic acid, esterification, benzoin, benzyl and benzylic acid, preparation of an organometallic compound and identification of unknown compounds, separation, purification and identification of components of mixtures. It also includes conducting preliminary tests, measuring physical properties, organic spectroscopy, elemental analysis, solubility, melting and boiling points, and preparing derivatives. **The course learning outcomes are:** 1. Gain knowledge of the structure and roles of proteins, including their kinetics, inhibitors, and amino acids. 2. Research the different properties of water as a biological solvent. 3. Research into the composition and capabilities of macromolecules such as fats and carbohydrates. 4. Research into macromolecule metabolism, including oxidative phosphorylation, citric acid cycle, glycolysis, electron transfer, and gluconeogenesis.	

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Course Name: organic Biochemistry	Course Code and Number: CHEM 418	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 311 and BIO101		
Course Description	This course comprises the structure and characteristics of biomolecules, including lipids, proteins, carbs, amino acids, and nucleic acids. This course will concentrate on the production and storage of metabolic energy, the primary metabolic pathways and their essential steps, and the relationship between the structure of proteins and their biological functions. Furthermore, the part that phospholipids play in defining the characteristics and functions of cellular membranes will be covered. **Course Objectives** 1. Draw and describe the structure(s) of amino-acids, lipids, nucleotides, and sugars. 2. Describe the physical-chemical properties of amino-acids, lipids, nucleotides, and sugars. 3. Understand the physical-chemical factors that influence the activity of proteins. 4. Understand the kinetics of enzyme activity and how this can be regulated by covalent modifications, allosteric factors, and gene expression. 5. Explain the molecular signaling pathways. **Course Learning Outcomes (CLOs)** 1. Gain knowledge of the composition and roles of proteins, including their kinetics, inhibitors, and amino acids. 2. Researching the different characteristics of water as a biological solvent. 3. To research the composition and capabilities of macromolecules such as lipids and carbohydrates. 4. Researching macromolecule metabolism, including oxidative phosphorylation, citric acid cycle, glycolysis, electron transport, and gluconeogenesis.	

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Course Name: Organometallic Chemistry	Course Code and Number: CHEM 421	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 321		
Course Description	The aim of this course is to provide a concise introduction to organometallic chemistry. This course is intended to senior undergraduate and post graduate students. It discusses organometallic chemistry of both transition metal and main-group elements making comparisons and contracts. The main contents of this course include definitions, properties nomenclature, classification, and stability of organometallic compounds. It discusses also the bonding theories of all types of organometallic compounds. Learning outcomes, the students will: 1. Understanding the nature of organometallic chemistry. 2. Study their properties, stability and reactivity of organometalic compounds. 3. Understanding the bonding modes depending on the nature of ligands.	

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Course Name: Description Chemistry of Chemical Elements	Course Code and Number: CHEM 422	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 321		
Course Description	The aim of this course is to provide an advanced knowledge of the inorganic chemistry to the elements of the main-groups. The contents of this course include the following : - Hydrogen, Atomic properties, uses, preparation - Alkali metals properties, preparation and uses - Alkaline earth metals, chemical and physical propertied, uses, reactions - Boron and Aluminum, their important compounds, structures, bonding and uses - Group IVA elements, carbon and silicon. Comparison study of their chemical compounds - Group VA elements (nitrogen and phosphorous) comparative study of their properties, chemical compounds - Group VIA and Group VIIA, properties, compounds, and uses Learning outcomes, the students will: Advanced knowledge about hydrogen and some their elements of the main groups with respect to their chemistry, industrial uses, structures of their compounds and bonding	

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Course Name: Heterogeneous Catalysis	Course Code and Number: CHEM 423	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 321		
Course Description	This is an applied course of chemistry. It delivers the main principles of heterogeneous catalysis to the 3rd and 4th year chemistry students. Course contents: Basic concepts of catalysis, activity and selectivity of catalysts, supported metal catalysts. metallic clusters, amorphous and crystalline alloy catalysts, catalyzed reactions and mechanisms, catalysts preparation, surface characterization, catalytic reactors. Some catalyzed industrial processes. Learning outcomes, the students will: 1. Understanding the main terms of heterogeneous catalysis. 2. The knowledge and ability of preparing and characterizing heterogeneous catalysts. 3. Understanding the role of catalysts in several industrial processes.	

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Course Name: Chromatography and Mass Spectrometry	Course Code and Number: CHEM 431	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 331, CHEM 334		
Course Description	Theory of chromatography, gas chromatography, high performance liquid chromatography, supercritical fluid chromatography, principle of mass spectrometry, ionization methods in mass spectrometry, types of analyzers in mass spectrometry, atomic mass spectrometry, molecular mass spectrometry, some of applications mass spectrometry in different branches of chemistry organic, inorganic, biological and analytical. Learning outcomes, the students will: 1. Explain basic principles of liquid chromatography (LC), gas chromatography (GC) and mass spectroscopy (MS). 2. Describe the principle of operation of the various components and tools of LC, GC, MS, LC-MS and GC-MS instruments 3. Identify some LC-MS and GC-MS applications in various fields	

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AP02-PR04		

Course Name: Advanced Instrumental Analysis	Course Code and Number: CHEM 432	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 331, CHEM 334		
Course Description	The objective of this course is to obtain a sound understanding of fundamental principles of instrumental methods of chemical analysis. The course will focus on the details of instrumental design and chemical properties of atoms and molecules that we can exploit for detection, selection, or quantitation. Topics include: Atomic X-ray Spectrometry, An Introduction to Infrared Spectrometry, Surface Characterization by Spectroscopy and Microscopy An Introduction to Electroanalytical Chemistry, Potentiometry, Coulometry, Voltammetry. Thermal Methods Learning outcomes, the students will: 1. Learn about different types of modern automatic analysis methods 2. Explain basic principles of potentiometic, electrogravimetric, coulometric, voltammetric and polarographic methods. 3. Identify some applications of X-ray Spectrometry and Surface Characterization	

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Course Name: Physical Chemistry (3)	Course Code and Number: CHEM 442	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 342, CHEM 345		
Course Description	**(Equivalent to CHEM 343)** This course provides advanced knowledge in the field of physical chemistry and includes the following subjects: Structure of matter and quantum chemistry, particlein a box, hydrogen atom, harmonic oscillator, rigid rotor, atomic spectra, molecular spectra, transport phenomena, surface chemistry. Learning Outcomes : KNOWLEDGE : - Students will know basic quantum mechanical description of chemical systems and its application in atomic and molecular spectroscopy. - Students will know wide aspects of surface and transport phenomena including surface tension, adsorption, surface reactions, diffusion, viscosity and sedimentaion. Learning outcomes, the students will: 1. Apply the principles of quantum mechanics to simple systems including the particle-in a-box, harmonic oscillator, rigid rotor and hydrogen atom. 2. Predict atomic spectra in absence and presence of external magnetic field. 3. Derive molecular properties based on spectroscopic data. 4. Define, derive and compute surface related thermodynamic quantities. 5. Derive and interpret the Langmuir adsorption isotherm as well as the rate laws of surface reactions. 6. Provide quantitative and qualitative description of diffusion, viscosity and sedimentation. 7. Have good skills in graph and data processing.	

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Course Name: Industrial Chemistry	Course Code and Number: CHEM 451	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 213, CHEM 341		
Course Description	This course represents an introduction into various chemical industries reflecting their importance in the prosperity of human civilization. Outlines: Energy resources, laws of conservation of mass and energy with applications in chemical industries, heat transfer, unit operations, distillation, extraction, reactor types and reaction kinetics, recovery and refining of petroleum, alkanes, alkenes and aromatics in chemical industry, detergents, paints, cement, fertilizers, plasticizers, plastics, natural polymers (cellulose, rubber) synthetic fibres, environmental issues of chemical industries. Learning outcomes, the students will: 1. Describe the chemical industry and identify the distinguishing features of its component parts. 2. Apply mass balance and energy balance in designing industrial plants. 3. Describe the advantages and disadvantages of the different energy resources. 4. Explain the importance and roles of route selection, process economics and process optimization in chemical processing. 5. Describe the industrial production of a number of important organic and inorganic chemicals. 6. Expand on the various types of catalysts and their role in the production of chemicals. 7. Evaluate environmental issues pertaining to the chemical industry. 8. Communicate effectively with industrial chemists.	

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Course Name: Computer Application in Chemistry	Course Code and Number: CHEM 452	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 342, Math 206		
Course Description	This course provides the student with computational skills to be used in the field of chemistry. It addresses the following points: The use of operation amplifiers to execute arithmetic operations, instruments, ontrol, data exchange and storage, data processing, drawing chemical structures and predicting their spectra, the search for chemical information in the internet. Learning outcomes: **KNOWLEDGE:** Students will know key concepts of computers, Boolean logic, diodes, transistors, hardware components, control of instruments, data aquisition and storage. Students will have also a basic knowledge of the chemistry of semiconductors. Learning outcomes, the students will: 1. Use data processing programs to analyze and plot data. 2. Use chemistry software to draw chemical structures, compute their chemical properties, predict ^{1}H and ^{13}C-NMR spectra. 3. Compute bond lengths, bond angles, energies, molecular orbitals, as well as IR spectra. 4. Use mathematics software to solve advanced problems in chemical kinetics, thermodynamics and simple quantum mechanical tasks. 5. Search and access chemical information in the internet and make use of chemical databases. 6. Evaluate and interpret chemical information and data.	

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Course Name: Environmental Chemistry	**Course Code and Number: CHEM 453**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: CHEM 221, CHEM 231		
Course Description	This course handles important environmental issues, causes and impact. The course topics are Overview of environmental science and technology; sources of pollutants, reactions, transport, effects, and fates of chemical species in water, soil, and air. Global environmental problems; ozone layer depletion, photochemical smog, suspended particles, greenhouse phenomenon, acid rain and their impacts. Different types of water, air and soil pollutants. Sampling of air, water and soil for chemical analysis. Common methods of analysis and the basis of choosing the appropriate technique Learning outcomes, the students will: 1. Understand global environmental problems and explain how they occur 2. Identify source of pollutants, reactions, transport and fates. 3. Understand the negative effects caused by environmental pollution 4. Explain basic principles of common methods of analysis and basics of choosing the appropriate method	

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Course Name: Computational Chemistry	**Course Code and Number: CHEM 455**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: CHEM 442 or concurrently		
Course Description	This course is designed for the student to learn the mathematical models behind various computational chemistry methods, as well as the practical aspects of carrying out calculations on chemical systems This course with include the following topics: Introduction to Computational ChemistryForce Fields / Molecular Mechanics, Semiempirical Theory, Ab Initio Hartree-Fock Theory, Density Functional Theory, Condensed-phase Calculations, Advanced Topics. Learning outcomes, the students will: 1.This course will provide the student with the background and resources necessary both to apply and to assess critically computational methodologies from a chemistry standpoint. 2. Introduce students to modern theoretical methods used in study of molecular structure, bonding, and reactivity concepts and practical applications. Ab initio and semi-empirical calculations of molecular electronic structure. 3. This course will provide the student with Computational tools for theoretical determination and hands-on experience	

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Course Name: Special Topics in Inorganic Chemistry	Course Code and Number: CHEM 492	Number of Credit Hours: 3
Teaching Language: English		
Pre-requisite: CHEM 321		
Course Description	This course emphasizes on studying in depth some specialized inorganic chemistry topics. These topics are related to the different research fields of the staff of the inorganic division. Learning outcomes, the students will: 1. Helping the students to understand the general principles of inorganic chemistry. 2. Understanding some specialized concepts of inorganic chemistry. 3. Preparing students for more advanced and specialized inorganic chemistry courses in the graduate level.	

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Course Name: Special Topics in Analytical Chemistry	**Course Code and Number: CHEM 493**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: CHEM 331		
Course Description	This course is designed to deepen the student's knowledge in advanced topics of analytical chemistry. The lecturer has the option of selecting the topics of this course taking into account the needs and interests of students. This course may be repeated under different topics. Learning outcomes, the students will: 1. Understand the latest methods of analysis that have not previously exposed 2. Understand most recent applications of specialized analytical methods. 3. Enhance the student's ability to complete graduate studies	

Course Name: Special Topics in Physical Chemistry	**Course Code and Number: CHEM 494**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: CHEM 342		
Course Description	This course is designed to deepen the student's knowledge in advanced topics of physical chemistry. The lecturer has the option of selecting the topics of this course taking into account the needs and interests of students. This course may be repeated under different topics. Learning outcomes, the students will: 1. Helping the students to understand the general principles of physical chemistry 2. Understand most recent applications of specialized physical methods. 3. Enhance the student's ability to complete graduate studies	

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Course Name: Special Topics in Organic Chemistry	**Course Code and Number: CHEM 495**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: CHEM 311		
Course Description	This course aims at giving the student deep knowledge in certain topic of Organic Chemistry related to the area of interest of the course instructor. Topics vary according to the interest of the course instructor. Learning outcomes, the students will: 1. Realize specialized concepts in certain area of Organic Chemistry. 2. Giving a deep Realization of Organic Chemistry as whole. 3. Enable students to pursue graduate studies	
Course Name: Research	**Course Code and Number: CHEM 499**	**Number of Credit Hours: 3**
Teaching Language: English		
Pre-requisite: Department Approval		
Course Description	This course aims to provide students with different research skills that qualify to do the laboratory work in independent and creative, course topics: Laboratory work varies diversity of research areas of the faculty members in the specialty field. Learning outcomes, the students will: 1. Provide creative research skills 2. Sharpen the student's personality to do the work independently laboratory 3. Student qualification to engage in graduate-based research track programs	