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

2024

Introduction

The educational program represents a coordinated and organized set of courses, including procedures and experiences structured as academic units. Its primary purpose is to build and refine the skills of graduates, making them qualified to meet the demands of the labor market. The program is reviewed and evaluated annually through internal or external auditing procedures, such as the External Examiner Program.

The academic program description provides a concise summary of the main features of the program and its courses, highlighting the skills that students are expected to acquire. These skills are aligned with the objectives of the academic program. This description is crucial as it forms the foundation for program accreditation, and its preparation involves teaching staff under the supervision of the scientific committees in the academic departments.

This second edition of the guide includes an updated academic program description, reflecting the revisions of course contents and sections of the previous guide in light of the developments in the Iraqi educational system. It covers both traditional academic structures (annual and semester-based) and the generalized academic program description approved by the Directorate of Studies, Letter No. T M3/2906 dated 3/5/2023, particularly for programs that follow the Bologna process.

In this context, it is important to emphasize the significance of preparing academic program and course descriptions to ensure the smooth and effective implementation of the educational process.

Concepts and Terminology

Academic Program Description: Provides a concise summary of the program's vision, mission, and objectives, including a precise description of the targeted learning outcomes based on specific learning strategies.

Course Description: Provides a brief summary of the main characteristics of a course and the expected learning outcomes for students, demonstrating whether they have maximized the learning opportunities available. Course descriptions are derived from the academic program description.

Program Vision: An ambitious depiction of the future of the academic program, portraying it as a progressive, inspiring, motivating, realistic, and applicable program.

Program Mission: Clarifies the goals and the necessary activities to achieve them in a concise manner and identifies the program's developmental paths and directions.

Program Objectives: Statements that describe what the academic program intends to achieve within a specific timeframe. They are measurable and observable.

Curriculum Structure: All courses or subjects included in the academic program according to the adopted learning system (semester-based, annual,

or Bologna process), whether they are required by the Ministry, University, College, or Academic Department, along with the number of credit units.

Learning Outcomes: A coherent set of knowledge, skills, and values acquired by the student upon successful completion of the academic program. Learning outcomes must be defined for each course in a way that achieves the program objectives.

Teaching and Learning Strategies: The strategies used by faculty members to enhance student learning. These are planned approaches followed to achieve learning objectives, encompassing all in-class and out-of-class activities to achieve the program's learning outcomes.

Academic Program Description Form

University Name: Basrah
Faculty/Institute: ...college of science
Scientific Department: ..chemistry
Academic or Professional Program Name: B.Sc... of chemistry
Final Certificate Name: ..B.Sc... of chemistry
Academic System: Course
Description Preparation Date: 10/9/2025
File Completion Date: 10/9/2025

Signature:
Head of Department Name:
Abbas Fadhil Abbas
Date: 10/9/2025

الاستاذ الدكتور
عباس فاضل عباس

Signature:
Scientific Associate Name:

Date:

الأستاذ الدكتور
عادل علي عبد الحسن
معاون العميد للشؤون العلمية والدراسات العليا

The file is checked by:
Department of Quality Assurance and University Performance
Director of the Quality Assurance and University Performance Department:
Date: Dunya Ali Hussain
Signature: 10/9/2025

Approval of the Dean
الاستاذ الدكتور
علي عبد الامام عبد الزهرة
عميد كلية العلوم / جامعة البصرة

.1 Program Vision

The Chemistry Department aims to be a leading and distinguished department among the Colleges of Science at the national, Arab, and international levels in the fields of theoretical and applied chemistry. The department's vision targets effective contributions to serving governmental institutions and society, while providing the labor market with qualified professionals across its various specializations, in full compliance with international quality standards and the Quality and Academic Accreditation Guide issued by the Ministry of Higher Education and Scientific Research.

· Program Mission2.

The program seeks to prepare and graduate outstanding scientific and research competencies in various branches of theoretical and applied chemistry, contributing to the development of knowledge in scientific research to serve the local, regional, and international community. Additionally, the program aims to train and refine students' skills academically and intellectually, emphasize academic, social, and cultural values, and respond to the needs of local, regional, and global labor markets.

3 Program Objectives

1. Embody the vision, mission, and objectives of the University of Basrah and implement best educational practices with a focus on ensuring and enhancing quality and performance in the fields of theoretical and applied chemistry.
2. Prepare specialized cadres capable of serving society and laying the groundwork for future specializations in modern chemistry and its applications.
3. Develop students' and faculty members' scientific and research capacities through educational and research activities that emphasize creativity and innovation in chemistry.
4. Strive to establish scientific and cultural cooperation agreements with peer departments and colleges locally, regionally, and internationally to achieve best practices in teaching, learning, and research.
5. Focus on the educational and ethical aspects of all department members, instilling a spirit of dedication, tolerance, and commitment to serving the nation and society.

Emphasize the intellectual and cultural development of students and maintain openness to experiences from other countries in the fields of chemistry and its industrial and research applications.•

6. Program Accreditation .
None.

7. Other External Influences .
Is there any sponsoring body for the program? The program is subject to the requirements of the national standards set by the Accreditation Council for Science Specializations Programs.

تمام، هاي ترجمة **هيكلية البرنامج** للإنجليزية بأسلوب أكاديمي وجاهز للاستخدام في دليل البرنامج:

8. Program Structure

Program Component	Number of Courses	Credit Units	Percentage	Notes
Institutional Requirements	6	13	9%	Core courses
College Requirements	8	23	16%	Core courses
Department Requirements	50	107	75%	Core + Elective courses
Summer Training	Yes	-	-	-
Others	-	-	-	-

First Year – Chemistry Program

Year / Level	Course Code	Course Title	Credit Units	Theoretical Hours	Practical Hours
First Year	TH101	Principles of Human Rights	3	3	0
	PD101	Physical Education	1	0	2
	AD101	Arabic Literature	2	2	0
	PH109	General Physics Principles	3	3	0
	BI103	Cell Biology	3	3	0
	MA101	Calculus I	3	3	0
	MA115	Mathematics for Chemistry	3	3	0
	CS127	Computer Basics	3	2	3
	CH101	Electronic Structure of the Atom	3	3	0
	CH102	Chemical Bonding	3	3	0
	CH131	Volumetric Analysis	4	3	3
	CH132	Gravimetric Analysis	5	3	6
	CH161	Chemical Safety and Security	1	1	0

Second Year – Chemistry Program

Year / Level	Course Code	Course Title	Credit Units	Theoretical Hours	Practical Hours
Second Year	TH201	Concepts of Freedom and Democracy	3	3	0
	MA214	Differential Equations	3	3	0
	CS260	MATLAB Applications	3	2	3
	GE275	Geochemistry	2	2	0
	CH201	Representative Elements Chemistry	4	3	3
	CH202	Coordination Chemistry	4	3	3
	CH211	Aliphatic Organic Chemistry	4	3	3
	CH212	Aromatic Organic Chemistry	4	3	3
	CH221	Thermodynamics	4	3	3
	CH222	Electrochemistry	4	3	3
	CH242	Biochemistry I	2	2	0

Third Year – Chemistry Program

Year / Level	Course Code	Course Title	Credit Units	Theoretical Hours	Practical Hours
Third Year	AD301	English Literature	2	2	0
	CH313	Stereochemistry	4	3	3
	CH314	Mechanism of Organic Reactions	4	3	3
	CH321	Chemical Kinetics	4	3	3
	CH323	Quantum Chemistry	3	3	0
	CH324	Spectroscopy	4	3	3
	CH342	Biochemistry II	3	2	3
	CH351	Industrial Chemistry	2	2	0
	CH352	Polymer Chemistry	4	3	3
	CH301	Organometallic Chemistry	2	2	0
	CH302	Nano Inorganic Chemistry	2	2	0
	CH315	Heterocyclic Chemistry	2	2	0
	CH325	Photochemistry	2	2	0
	CH333	Green Chemistry	3	3	–
	CH334	Separation Techniques	2	2	0
	CH343	Clinical Biochemistry	3	2	3
	CH353	Petroleum and Petrochemicals Technology	3	2	3

	CH354	Industrial Applications	2	2	0

Fourth Year – Chemistry Program

Year / Level	Course Code	Course Title	Credit Units	Theoretical Hours	Practical Hours
Fourth Year	EV400	Environmental Awareness	2	2	0
	CH416	Organic Analysis	5	3	6
	CH431	Analytical Chemistry	4	3	3
	CH490	Research Project	2	2	0
	CH401	Transition Elements Chemistry	4	3	3
	CH402	Selected Topics in Inorganic Chemistry	3	3	0
	CH403	Aqueous Solutions Chemistry	3	3	0
	CH404	Bioinorganic Chemistry	3	3	0
	CH417	Selected Topics in Organic Chemistry	3	3	0
	CH418	Advanced Organic Chemistry	3	3	0
	CH425	Advanced NMR Spectroscopy	3	3	0
	CH426	Nuclear Radiochemistry	3	3	0
	CH427	Selected Topics in Physical Chemistry	3	3	0

	CH428	Advanced Electrochemistry	3	3	0
	CH432	Electroanalytical Chemistry	4	3	3
	CH444	Selected Topics in Biochemistry	3	3	0
	CH445	Biotechnology	3	3	0
	CH451	Industrial Pollution Chemistry	3	3	0
	CH454	Introduction to Petrochemicals	3	3	0
	CH455	Polymer Manufacturing	3	2	3
	CH456	Industrial Chemical Additives	3	3	0
	CH460	Computational Chemistry	3	2	2

8. Expected Learning Outcomes of the Program

Knowledge

1. Ability to distinguish between different branches of chemistry (organic, inorganic, analytical, physical, industrial, and biochemistry) and understand the fundamental principles underlying each branch.
2. Ability to interpret chemical phenomena and propose scientific solutions to problems related to chemical substances and their industrial and environmental applications.
3. Familiarity with the principles of chemical safety and chemical management, recognizing hazards and proper handling procedures.

Skills

1. Ability to perform chemical experiments in the laboratory using modern instruments and techniques while adhering to quality and safety standards.
2. Ability to analyze chemical data using statistical methods and computer software, deriving accurate scientific conclusions.
3. Ability to apply chemical knowledge in designing and developing new materials or compounds with practical applications in industry, environment, and health.

Values

1. Ability to work effectively in teams and communicate efficiently with others in academic, research, and industrial settings.
2. Commitment to academic and professional ethics in scientific research and practical applications.
3. Readiness for continuous learning and openness to new scientific and technological developments in the field of chemistry.

9. Teaching and Learning Strategies

- Use of interactive theoretical lectures supported by modern teaching aids (presentations, educational videos, computer simulations) to explain chemical concepts.
- Emphasis on practical aspects through laboratory experiments, training on modern instruments, and linking results to theoretical concepts.
- Implementation of blended learning (face-to-face and online) to develop student skills and enhance self-directed learning.

- Encouragement of student participation in discussion sessions, scientific seminars, and workshops to increase interaction and build confidence.
- Adoption of individual and group research projects in advanced stages of study to develop scientific research skills and problem-solving abilities.
- Integration of curricula with chemical applications in industrial, environmental, and medical fields to prepare students for the labor market.
- Continuous monitoring of student performance through periodic assessments, feedback, and encouragement to improve scientific and cognitive skills.

10. Assessment Methods

- **Written Examinations:** To measure students' understanding of fundamental theoretical concepts in various chemistry branches.
- **Practical and Laboratory Examinations:** To evaluate students' skills in conducting experiments, measurement accuracy, and data analysis.
- **Reports and Homework Assignments:** To encourage research, reading, and development of scientific writing and analytical skills.
- **Presentations:** To assess students' oral presentation skills, organization of ideas, and scientific communication.
- **Research Projects:** To evaluate problem-solving abilities, application of chemical knowledge in different fields, and development of research skills.
- **Class Participation and Discussions:** To measure engagement, contribution to discussions, and critical thinking.
- **Continuous Assessment (Formative Assessment):** Through short tests, in-class questions, and direct observations to evaluate academic progress continuously.

9. Teaching and Learning Strategies

- Adoption of interactive theoretical lectures supported by modern teaching aids (presentations, educational videos, computer simulations) to clarify chemical concepts.
- Emphasis on practical aspects through conducting laboratory experiments, training on modern instruments, and linking results to theoretical concepts.
- Implementation of blended learning (face-to-face and online) to develop students' skills and enhance self-directed learning.
- Encouragement of student participation in discussion sessions, scientific seminars, and workshops to increase interaction and build confidence.
- Adoption of individual and group research projects in advanced stages of study to develop research skills and problem-solving abilities.
- Integration of curricula with applications of chemistry in industrial, environmental, and medical fields to prepare students for the labor market.
- Continuous monitoring of student performance through periodic assessments, feedback, and encouragement to improve scientific and cognitive skills.

10. Assessment Methods

- **Written Examinations:** To measure students' understanding of fundamental theoretical concepts in various branches of chemistry.
- **Practical and Laboratory Examinations:** To evaluate students' skills in conducting experiments, measurement accuracy, and data analysis.
- **Reports and Homework Assignments:** To encourage research and reading, and to develop students' scientific writing and analytical abilities.

- **Presentations:** To assess students' oral presentation skills, organization of ideas, and scientific communication.
- **Research Projects:** To evaluate students' problem-solving abilities, application of chemical knowledge in different fields, and development of research skills.
- **Class Participation and Discussions:** To measure engagement, contribution to discussions, and critical thinking.
- **Continuous Assessment (Formative Assessment):** Through short quizzes, in-class questions, and direct observations to evaluate academic progress on an ongoing basis.

11. Academic Staff

Faculty Members

Academic Rank	Specialization	Specific Requirements/Skills (if any)	Number of Staff
Professor	Organic Chemistry	–	6
Professor	Inorganic Chemistry	–	5
Professor	Physical Chemistry	–	6
Professor	Biochemistry	–	7
Professor	Polymer Chemistry	–	4
Professor	Analytical Chemistry	–	3
Assistant Professor	Organic Chemistry	–	2
Assistant Professor	Inorganic Chemistry	–	2
Assistant Professor	Physical Chemistry	–	1
Assistant Professor	Biochemistry	–	2

Assistant Professor	Polymer Chemistry	–	2
Assistant Professor	Analytical Chemistry	–	1
Lecturer	Organic Chemistry	–	2
Lecturer	Analytical Chemistry	–	1
Assistant Lecturer	Chemistry	–	7

Professional Development

Orientation for New Faculty Members

- Prepare an orientation program that explains the academic and administrative policies of the department and university.
- Involve new faculty members in introductory courses on effective teaching methods and classroom management.
- Provide them with a laboratory manual including safety instructions and best practices for equipment use.
- Assign an experienced faculty member as an academic supervisor to monitor the new faculty's performance and provide necessary support.

Ongoing Professional Development for Faculty Members

- Organize regular workshops and training courses in modern teaching methods, e-learning techniques, and assessment strategies.
- Encourage faculty to participate in local and international scientific conferences and seminars to enhance research and communication skills.
- Support publishing in reputable scientific journals and promote collaborative research between department members and counterpart departments.

- Motivate faculty to develop and update curricula, linking them to labor market requirements and modern developments in chemistry.
- Provide advanced training programs in using modern instruments and advanced chemical analysis techniques.

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12. Admission Criteria

- The central distribution by the Ministry of Higher Education and Scientific Research determines the students admitted to the College of Science, University of Basrah.
- Students are distributed among the departments of the College of Science (including the Chemistry Department) based on competitive total scores and comparative course grades.
- The capacity plan for the Chemistry Department in the previous academic year was **150–200 students**.

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13. Key Sources of Program Information

1. Chemistry Department webpage on the College of Science / University of Basrah website.
2. Chemistry Department Guide.
3. Ministry of Higher Education and Scientific Research website.

14. Program Development Plan

1. **Utilization of Modern Scientific Sources:** Continuously update the curricula using the latest reputable global scientific books and references.
2. **Regular Review of the Curriculum:** The department's academic committee regularly reviews and evaluates the program content to ensure its quality and relevance.
3. **Future Development Plans:** Establish specialized committees for curriculum, laboratories, and procurement to enhance the educational and research environment.
4. **International Collaboration:** Encourage cooperation and twinning with prestigious international universities, including academic exchanges and expertise sharing, to achieve scientific openness and continuous improvement.

Curriculum Skills Mapping
Program Learning Outcomes Mapping

Year/Level	Course Name	Core / Elective	Knowledge Objectives (A1–A4)	Program-Specific Skills (B1–B4)	Values & Attitudes (C1–C4)	General & Transferable Skills (D1–D4)
1st Year	Electronic Structure of the Atom	Core (Department)	X	X	X	X
1st Year	Chemical Bonding	Core (Department)	–	–	–	–
1st Year	Volumetric Analysis	Core (Department)	X	X	X	X
1st Year	Gravimetric Analysis	Core (Department)	–	–	–	–
1st Year	General Physics Principles	Core (College)	X	X	X	X
1st Year	Calculus 1	Core (College)	X	X	X	X
1st Year	Mathematics for Chemistry	Core (College)	–	–	–	–
1st Year	Programming in BASIC	Core (College)	X	X	X	X
1st Year	Physical Education	Core (College)	X	X	X	X
1st Year	Arabic Language	Core (College)	X	X	X	X
1st Year	Principles of Human Rights	Core (College)	X	X	X	X
1st Year	Chemical Safety & Security	Core (College)	X	X	X	X

Second Year

Year / Level	Course Code	Course Name	Units	Credit Hours (Theory)	Credit Hours (Practical)
2nd Year	CHEM201	Representative Elements Chemistry	4	3	3
2nd Year	CHEM202	Coordination Chemistry	4	3	3
2nd Year	CHEM211	Aliphatic Organic Chemistry	4	3	3
2nd Year	CHEM212	Aromatic Organic Chemistry	4	3	3
2nd Year	CHEM221	Thermodynamics	4	3	3
2nd Year	CHEM222	Electrochemistry	4	3	3
2nd Year	CHEM242	Biochemistry 1	2	2	0
2nd Year	MATH214	Differential Equations	3	3	0
2nd Year	COMP260	MATLAB Applications	3	2	3
2nd Year	PHIL201	Concepts of Freedom & Democracy	3	3	0
2nd Year	GEOL275	Geochemistry	2	2	0

Third Year

Year / Level	Course Code	Course Name	Units	Credit Hours (Theory)	Credit Hours (Practical)
3rd Year	CHEM313	Stereochemistry	4	3	3
3rd Year	CHEM314	Mechanism of Organic Reactions	4	3	3
3rd Year	CHEM321	Chemical Kinetics	4	3	3
3rd Year	CHEM323	Quantum Chemistry	3	3	0
3rd Year	CHEM324	Spectroscopy	4	3	3
3rd Year	CHEM342	Biochemistry 2	3	2	3
3rd Year	CHEM351	Industrial Chemistry	2	2	0
3rd Year	CHEM352	Polymer Chemistry	4	3	3
3rd Year	LANG301	English Language	2	2	0
3rd Year	CHEM301	Organometallic Chemistry	2	2	0
3rd Year	CHEM315	Heterocyclic Chemistry	2	2	0
3rd Year	CHEM325	Photochemistry	2	2	0

3rd Year	CHEM334	Separation Techniques	2	2	0
3rd Year	CHEM343	Clinical Biochemistry	3	2	3
3rd Year	CHEM353	Petroleum & Petrochemicals	3	2	3
3rd Year	CHEM333	Green Chemistry	3	3	-
3rd Year	CHEM302	Nano-Inorganic Chemistry	2	2	0

Fourth Year

Year / Level	Course Code	Course Name	Units	Credit Hours (Theory)	Credit Hours (Practical)
4th Year	CHEM416	Organic Analysis	5	3	6
4th Year	CHEM431	Industrial Chemistry	4	3	3
4th Year	CHEM490	Research Project	2	2	0
4th Year	ENV400	Environmental Awareness	2	2	0
4th Year	CHEM401	Transition Elements Chemistry	4	3	3
4th Year	CHEM402	Selected Topics in Inorganic Chemistry	3	3	0
4th Year	CHEM403	Non-Aqueous Solutions Chemistry	3	3	0
4th Year	CHEM404	Bioinorganic Chemistry	3	3	0
4th Year	CHEM417	Selected Topics in Organic Chemistry	3	3	0
4th Year	CHEM418	Advanced Organic Chemistry	3	3	0
4th Year	CHEM425	Advanced NMR	3	3	0
4th Year	CHEM426	Nuclear Radiochemistry	3	3	0
4th Year	CHEM427	Selected Topics in Physical Chemistry	3	3	0
4th Year	CHEM428	Advanced Electrochemistry	3	3	0
4th Year	CHEM432	Electroanalytical Chemistry	4	3	3
4th Year	CHEM445	Biotechnology	3	3	0
4th Year	CHEM454	Introduction to Petrochemicals	3	3	0
4th Year	CHEM455	Polymer Manufacturing	3	2	3
4th Year	CHEM451	Industrial Pollution	3	3	0

University of Basrah

College of Science

Department of Chemistry

Academic Program Description

Description of the courses of the Department of Chemistry

CHEM201 Elements represented in the periodic table where elements study their existence, general characteristics and interactions

Curriculum K 201

1- Elements represented

Position in the periodic table – Cyclicity of traits – Ionization energy – Electron affinity – Electronegativity – Atomic radius – Covalent radius – Metallic traits

2- Hydrogen and hydrides

Its existence, general characteristics and interactions - Hydrogen isotopes - Its production in industry and its uses - Hydrogen isomers (ortho and para hydrogen) - Hydrides and their types - Structure - Hydrides of group elements

3- Alkaline elements

General characteristics - preparation - presence - halides - oxides - hydrides - sulfates - similarity between lithium and magnesium .

4- Alkaline earthy elements

General characteristics - preparation - presence - halides - oxides - hydrides - similarity between beryllium and aluminum .

5- Boron and aluminum group

Introduction – Preparation and Qualities – Halides – Oxides – Alum – Hydrides – Complexes – Nitrogenous compounds of boron

6- Carbon and silicon group

Elements and their characteristics - halides - carbides - oxides - hybridization - elements of germanium, tin and lead - their qualities and preparation and the most important compounds and uses.

7- Oxygen and sulfur group (galcogens)

Characteristics of the elements, their presence and methods of obtaining them - the most important compounds - oxides, peroxides and peroxides .

8- Halogen group

Introduction – Presence – Separation Methods – Characteristics – Halogen and Oxyhalogen Acids – Their Compounds

9- Noble gas group

General characteristics – compounds – uses

10- Parity

The importance of symmetry in chemistry - symmetry processes - examples

Sources :

Comparative Inorganic Chemistry and Composition - translated by Dr. Mahdi Naji Al-Zakom 1-

Chemistry of the elements represented d. Mahdi Naji Al-Zakum and Dr. Kazem Al-Obaidi 2-

Basic Inorganic Chemistry (Part 1) translated by Dr. Mahdi Naji Al-Zakom. 3-

CHEM202 / Chemistry Coordination: Teaching the student the shapes and characteristics of complexes according to scientific theories.

Curriculum CHEM202

Introduction to transitional elements 1-

Introduction to the emergence of theories of synergy 2-

Naming complex compounds 3-

Crystal field theory 4-

Dichotomy of d orbitals for different symmetry preparation – crystalline field stability energy of high twist and low twist complexes

Valence Theory – Hybridization of Atomic Orbitals 5-

Lycandy field theory 6-

Orbital molecular theory 7-

A comparison of the success and inadequacy of theories of contemporaneity 8-

Spectral and magnetic properties of complex compounds 9-

Stereochemistry of complex compounds of symmetry numbers 4 and 6 10-

Preparation and reactions of complex compounds 11-

Carbonyl compounds 12-

Preparation – interactions – properties

Sources

Coordinated Chemistry Written by Dr. Essam Zarzis Salloumi 1-

The Chemistry of Transition Elements - written by Dr. Mahdi Naji Al-Zakum 2-

Coordinated Chemistry - written by Yaslow and Johnson - translated by Dr. Ali Falih Ajam 3-

Basic inorganic chemistry by Cotton and Wilkinson 4-

CHEM211 / Organic Chemistry: Introducing students to the chemistry of hydrocarbons, especially organic aliphatic and their derivatives such as alcohols, aldehydes, ketones, carboxylic acids, amines, etc., as well as the course gives an overview of the importance of each of these varieties, their interactions, properties, methods of preparation and their industrial or biological importance.

Curriculum 211

Structure and properties of the carbon atom 1-

Alkanes – Cyclic alkanes 2-

Alkenes – Nomenclature 3-

Alkynes – nomenclature and geometric similarity 4-

Dines - Types - Add 1, 4 5-

Alkyl halides 6-

Alcohol 7-

Ethers 8-

Aldehydes and ketones 9-

Carboxylic acids – acids 10-

Carboxylic acid derivatives – their effectiveness 11-

Halides Acids – Hydrides – Esters – Amides
Amines 12-
The above vocabulary includes naming – preparation methods – interactions
Sources
Organic chemistry by Roberts Stewert and Casiro 1-
Organic chemistry by Morrison and Boyed 2-
Intensive Introduction to Organic Chemistry - translated by Dr. Fadel 3-
Kamouna and Dr. Iqbal Al-Shaibani
Organic Chemistry translated by Raad Al-Hamdani and Ismail Bassiouni 4-
A comprehensive look at organic chemistry translated by Muhammad Nizar 5-
Fundamentals of Organic Chemistry by Dr. Qais Atwan Sharif 6-

C212 / Aromatic organic chemistry: Organic chemistry in general is concerned with the study of compounds inside and outside the body of the organism and therefore called organic and most of the compounds in the ground of plants and animals are organic and a large part of them aromatic compounds found in crude oil and some plants. Therefore, the student's study of these compounds in terms of isolation or preparation and interactions gives an understanding of the existence of these compounds and their importance in terms of some of them are drugs such as paracetol and some in the manufacture of perfumes and dyes.

Curriculum CHEM212

Comparison of Benzene to Alkenes – Stability of Aromatic Benzene 1-
Compounds
Chemistry of benzene and its derivatives – nomenclature – physical and 2-
chemical properties
Electrolytic aromatic prostheses 3-
Halogenation – sulfonation – nitrification – alkylation – fluidity – compensator guidance
Arinat 4-
4-1 - Chemistry of aryl halides
4-2 - chemistry phenols and quinones
4-3 - Chemistry of sulfonic acids and carboxylic acids
4.4 Chemistry of aldehydes, ketones and alcohols
4.5 Chemistry of nitrogen compounds
4-6- Derivatives of lateral chain aromatic compounds
4-7 - Chemistry of aromatic compounds with more than one ring benzene
4-8- Introduction to chemistry of heterocyclic compounds
4-9- Acidic and basic aromatic organic compounds

Sources

Organic chemistry by Roberts Stewert and Casiro 1-
Organic chemistry by Morrison and Boyed 2-
Aromatic chemistry by Warning 3-
Intensive Introduction to Organic Chemistry - translated by Fadel Kamouna 4-
and Iqbal Al-Shaibani
Organic Chemistry translated by Raad Al-Hamdani and Ismail Bassiouni 5-
A comprehensive look at organic chemistry translated by Muhammad Nizar 6-
Fundamentals of Organic Chemistry by Qais Atwan Sharif 7-

CHEM221 / Thermodynamics: Study of the relationships between heat, labor, temperature and energy. The laws of thermodynamics describe how energy changes in a system and whether a system can perform useful work with its surroundings.

Curriculum C221

The first law of thermodynamics

Introduction – Modular System SI- Properties of systems - chemical thermodynamics - terms used in thermodynamics: standard state, thermodynamic system and its surroundings, state of thermodynamic system, system variables, thermodynamic functions . 1-

Reversible and non-reversible and automated operations 2-

Energy 3-

Thermal energy – work done in the expansion and compression processes of ideal gases – chemical energy or internal energy 4-

Zero Law of Thermodynamics 5-

The First Law of Thermodynamics - Isothermatic and Adibatic Processes - Heat Capacity of Ideal Gases - Applications of the First Law of Thermodynamics - Heat Capacity - Reversible and Irreversible Isothermal Expansion and Contraction Processes - Adidactic Reversible Expansion Processes - Joule Thomson Coefficient - The relationship between enthalpy and internal energy

II. Thermochemistry

Introduction - Rapid reaction and full interaction - pure interaction - standard state and agreed signal 1-

Heat reaction 2-

Laws of Thermochemistry 3-

Hesse's law of constant addition – Composition heat – Solution temperature – Exchange heat – Combustion heat – Temperature change of reaction with temperature – Bond energy – Examples

Second law of thermodynamics

Introduction and text of the law – Cartoon cycle – Cartoon cycle efficiency – Entropy changes for reversible and non-reversible processes – Entropy changes for gas systems – Entropy changes for liquid and solid systems – Entropy change for a mixture of ideal gases – Integration of the first and second laws of thermodynamics

IV. Free Energy

Introduction to derivation of the equation of free energy - the dependence of free energy on pressure - free energy for chemical reaction - the dependence of free energy on temperature: A- Gypsum equation B- Helmholtz equation C- Clapeyron equation D- Clausius-Clabyrne equation 1-

Chemical Systems 2-

Basic Equations of Closed Systems – Maxwell Relationships

Chemical Potential 3-

molar molar volumes 4-

Free energy and measured free energy and their relationship to the equilibrium constant 5-

Dependence of the equilibrium constant on temperature (Vant Hof equation) 6-

Ideal and non-ideal solutions - Rault's law - aggregate properties (decrease in vapor pressure - decrease in freezing point - increase in boiling point - osmotic pressure) 7-

Sources

1- Physical Chemistry (Theoretical Foundations and Applications) authored by Anis Abdul Wahab Al-Najjar - Mosul University Press - 1986

2- Physical Chemistry (Advanced Problems and Solutions) written by Anis Abdul Wahab Al-Najjar and Khaled Al-Ani - Basra University Press - 1980

3- Physical Chemistry - authored by Jalal Muhammad Saleh - Baghdad University Press - 1977

4- Physical chemistry , By Atkins – oxford press

CHEM222 / Electrochemistry: Electrochemistry gives information about a number of phenomena such as metal technology, corrosion, the cause of corrosion, the study of cells generating electricity directly, and knowledge of how redox reactions occur.

Curriculum K 222

1- Electrical conductivity

General introduction – Metal conduction and electrolytic conductivity – Types of electrical conductivity – Types of liquids – Units used in electrochemistry – Fradi's laws of electrolysis – Electrochemical equivalent – Electrochemical reactions (comparison between molten salts and aqueous media)

2- Measurements of electrical conductivity Specific resistance and Ohm's law - Specific conduction - Cell constant - Equivalent conduction and molar conduction - Direct current and alternating current - Wheatstone bridge

3- Electrical conductivity change with concentration

Strong electrolytes (fully dissociated) and weak electrolytes (incompletely dissociated) - Kohlrach equation - molar and equivalent conduction at zero concentration - The origin of electrolytic theory (Arenus' law - How to determine λ^o in weak electrolytes - Kohlrach's law of independent ion migration - Ostwald's law of dilution

4- Ionic transition

Transition Preparation (Single Solution and in Mixture) Transition Preparation Measurement (1-Hiturf Method 2-Moving Separation Limit Method) Transition of hydrogen and hydroxyl ions – Optimization of ion model in aqueous solutions (solvent role and dielectric constant) – Ionic activity coefficients and their dependence on the ionic intensity of the solution – Deby's theorem – Structure and coefficient of effectiveness – Electrical conductivity theory – Voss equation – Unsacker – Ionic assembly – Walden rule – Practical applications of electrical conductivity measurement (dissociation constants for weak acids and bases) – Hydrolysis constants – Hydrations for measuring electrical conductivity) – Solubility of sparsely soluble electrolytes – Ion yield of water

5- Electrochemical cells at equilibrium

6- General Introduction – Double Electric Layer – Definition of Cell Potential Difference – Electric Potential Difference of Galvanic Cells – Electromotive Force and Cell Interactions – Circuit Bonding – Standard Weston Cell and Thermal Treatments – Types of Semi-Cells (Electrodes) – Gas Electrodes – Metal Electrodes and their Ions – Amalgamated Electrodes – Oxidation and Reduction Electrodes – Non-Gas Non-Metal Electrodes – Metal electrodes and insoluble salt such as (Ag/AgCl) and calomel electrode (Hg/Hg2Cl2)) – Metal electrodes and sparsely soluble oxide

7- Reflex cells

Changes in the free energy of cell reactions – Electrode voltage and how to calculate it – Standard driving force of cells – Dependence of E on concentration and efficiency – Thermodynamic functions of the electrochemical cell – Standard applications E (Determination of standard electrode potentials – Determination of efficiency coefficients – Determination of thermodynamic dissociation constants and dissolution products – Calculation of the ionic quotient of water – pH measurements – Hydrogen electrode – Oxygen electrode – Quinone electrode – Glass electrode and its types – Hydration Jihadism

8- Focus cells

Polarity and electrolytic with and without transition

9- Electrical cells at imbalance

Non-reversible cells and polarization – dissociation potential – supervoltage – cells with fixed poles – mechanics of processes at poles – specific current (diffusion current) – electrochemical corrosion (general introduction)

CHEM315 / Heterogeneous aromatic compounds: Introducing students to the names and composition of heterogeneous aromatic compounds, as well as methods of preparation and interactions because of their great importance, as this type of compounds is involved in many aspects of life such as pharmaceutical industries.

Curriculum CHM 305

1- General introduction

2- Heterocyclic compounds similar to cyclopentadiene ring containing a heterogeneous atom

2.1 Pyrrole

2.2 Fioran

2.3 Theofen

3- Compounds similar to benzene containing a heterogeneous atom: pyridine

4- Pentacombs containing two heterogeneous atoms

4.1 Perazole

4.2 Amidazole

5- Ring compounds similar to naphthalene containing a heterogeneous atom

5.1 Quinoline

5-2- Isoquinoline

6- Hexagonal cyclic compounds containing two heterocyclic atoms: pyridazine

7- Naphthalene-like cyclic compounds containing two heterogeneous atoms: Synolin

8- Cyclic compounds fused with pyrol ring, indole

Each chapter includes chemical and physical properties – preparation methods – reactions and presence.

Sources

1- Introduction to the Chemistry of Heterocyclic Compounds - translated by Dr. Fadel Kamouna and Dr. Iqbal Al-Shaibani

2- The chemistry of hetrocycles by Hans Suschitzky and Judith Suschitzky

CHEM321 / Kinetic Chemistry: The course aims to introduce the student to the mechanics of reactions, calculate the speed of reactions and the extent of consumption of quantities of reactants over time in terms of concentrations, volumes or pressures, especially for gaseous substances, determine the paths of reactions, arrange the reaction, classify reactions according to phases and molecular multiplexy, and how to calculate the energy associated with the occurrence of the reaction, such as activation energy and thermodynamic functions to which the rates of speed of reactions are related. It is also possible to identify cofactors and temperature and how these two factors affect the rate of speed of reactions, in addition to studying multiple types of reactions.

Curriculum CHEM321

1- Kinetics of chemical reactions

Overview – Classification of reactions according to (phase, molecular multiple, reaction rank) – Definition of each of (degree of reaction – rate of reaction speed, constant rate of reaction speed, half-life)

2- Degrees of interaction

2-1- Grade Zero Reactions – Calculation of Reaction Speed Rate – Reaction Rate Constant – Half-Life

2-2 - First order reactions - calculation of the rate of reaction speed - constant reaction speed rate - half-life - calculation of the first degree in terms of (concentrations, volumes, pressure, absorption, conductivity, angle of polarization, nuclear reactions)

2-3- Second degree interactions with similar and different concentrations - calculation of the reaction speed rate, reaction speed rate constant, half-life, special second degree, nomadic reactions of the first degree

2-4 - Third degree interactions class (first, second and third) - calculation of the rate of reaction speed - constant rate of reaction speed - half-life

2-5- Class N reactions - calculation of the reaction speed rate - reaction rate constant - half-life

3- Methods for finding the degree of interaction

3.1 Method of change of ratios

3-2 - method of integration or attempt - theoretical application - graphic methods

3-3 - methods of half-life - graphical method - the relationship between half-life and the rate of reaction speed - practical method - the relationship between half-life and primary focus

3-4 - Differentiation method - theory - graphically

3.5 Initial velocity rate method for complex reactions

3.6 Insulation method

4- Complex interactions

4-1- Opposite reactions, calculations of differential and integral equations (1st X1st $[B]_{0=0}$) Determination of K1 and K-1 value of slope and in terms of concentrations and equilibrium constant, (1st X1st [B]0= b), (1st X2nd), (2nd X 1st) (X2nd 2nd)

4-2- Successive interactions, calculations of differential and complementary equations to calculate concentrations A, B, C and the time required for the highest concentration of B

4-3 - Parallel interactions class I and II - calculations of differential and complementary equations for the calculation of concentrations A, B, C for the two classes

4-4- Chain reactions - calculation of the rate of reaction speed - steady state hypothesis - determination of reaction mechanism - specific step method for reaction speed

5- The effect of temperature on the rate of reaction speed - activation energy - Arrinius equation - calculation of thermodynamic functions according to Arrinius' theory

6- Theories of reaction speed

1- 1- Collision theory - productive and non-productive collision - calculation of the total collision frequency (for one molecule, for different molecules, for similar molecules) - calculation of the average speed of the molecule - calculation of the active part of collisions - calculation of the reaction speed rate - calculation of the reaction speed rate constant - calculation of frequency coefficient - calculation of activation energy - calculation of vacuum obstruction coefficient.

2- -2- Active complex theory - Calculation of the reaction speed rate - Calculation of the reaction speed rate constant - Calculation of thermodynamic

functions according to the active complex theory - Calculation of frequency coefficient - Calculation of activation energy - Calculation of the reaction velocity constant for solutions and gases - Difference between collision theory and active complex theory

7- Factors affecting the rate of reaction speed

7-1- Solvent effect – dissolving process – dielectric constant – solvent viscosity

7-2- The effect of pressure on the rate of reaction speed - the volume of activation - the calculation of the constant rate of reaction speed in terms of pressure

7-3- The effect of ionic force on the rate of reaction velocity - Debye Hegel's equation - ionic intensity - the main effect of salt Brønstedt-Gram's equation - the secondary effect of salt

8- Quick interactions

8-1- Flow methods - contact methods - fixed flow method - moving flow method -

8-2- Loosening method - derivations of lax time

9- Cofactors

Homogeneous catalysts – Heterogeneous catalysts – Qualitative stimulation – General catalysis – Enzymes as catalysts – Michalis constant

Sources

1- Physical Chemistry (Advanced Problems and Solutions) written by Anis Abdul Wahab Al-Najjar and Khaled Al-Ani - Basra University Press - 1980

2- Principles of the speed of chemical reactions written by Ali Abdul Hussein Saeed

3- Kinetic and electrochemistry written by Ahmed Hashem Al-Dabbagh and Banan Akrawi

4- Physical chemistry , By Atkins – oxford press

5- Physical chemistry by Moore , Logman 1962

6- Elementary reaction kinetic by latham

CHEM324 / Molecular Spectroscopy Chemistry: Definition of Permian Electronic Resonance – Theory – ESR Signal Origin – Zeman Effect – G Factor – Ultrafine Pairing – Glass Solutions – Relative Intensity and Number of Beams – Permian Electronic Resonance Spectra for Free Radicals – Permian Electronic Resonance Spectra for Transition Elements – Uses and Applications. Maspor spectroscopy Maspor effect – isotope displacement – Nuclear tetrachute dichotomy – Magnetic superfine mutual effect – Applications

Curriculum CHM 324

1- Introduction

Electromagnetic radiation – Quantization of energy – Schrödenker equation Spectrum regions – Width and intensity of electronic transitions – Basic components of the spectrum

2- Microwave spectroscopy

Molecular rotation – Rotation spectra – Diatomic particle rotation spectra – Hard rotor – Isotope compensation effects – Non-rigid rotor – Spectral line intensity – Multiatomic molecule rotation spectra – Applications

3- Infrared spectroscopy

Diatomic particle vibration – Diatomic molecule vibration spectra – Harmonic vibrator – Aharmonic vibrator – Rotation vibration of diatomic molecules – Bourne Oppenheimer approximation insufficiency – Polyatomic atom vibration – Applications

4- UV and visible spectroscopy

Electron spectroscopy – Diatomic molecule spectra – Multiatomic molecule spectra – Charge transfer spectra – D-D transitions – Applications

5- Nuclear magnetic resonance spectroscopy

Magnetic properties of nuclei – Ziman mutual effect – resonance conditions – chemical displacement – twirl twirl – analysis of nuclear magnetic resonance spectra – applications

6- Permian electronic resonance spectroscopy

Magnetic properties of the electron – Reciprocal effect of Zeman – Resonance conditions – G-factor – Ultrafine pairing – Permian electron resonance of free radicals – Permian electronic resonance factor of elements

7- Maspar spectroscopy

8- Probe effect – isotope displacement – tetrapole nuclear couple – magnetic superfine mutual effect – Applications

CHEM342 / Metabolic Biochemistry: Identify the metabolic interactions of biological compounds and what are their metabolic products. and how to regulate metabolic reactions.

Curriculum CHEM342

1- Vitamins (composition and classification)

Fat-soluble vitamins - water-soluble vitamins

2- Chemistry of hormones

Thyroid hormone – pancreatic hormone (insulin and cocacon) – adrenaline hormone –

3- Biological oxidation

Enzymes associated with redox reactions – high-energy compounds in biological oxidation – foundations and laws in energy production

4- Carbohydrate metabolism –

Anaerobic oxidation (glycolisis) – Construction and catabolism of glycogen – Aerobic oxidation (crepe cycle and tricarbosyl acid cycle) – Cycle of pen-phosphate sugar – Preparation or construction of glucose from non-carbohydrate sources

5- Fat metabolism

Fatty compounds prevalent in the blood – lipid oxidation – lipid biosynthesis – unsaturated fatty acid metabolism – ketone bodies –

6- Protein metabolism

Nitrogen balance – Amino acid catabolism – Cracking of the carbon structure of amino acids – Urea cycle – Amino acid biosynthesis – Protein biosynthesis

CHEM343 / Clinical Biochemistry: Objectives: Introduce the student to clinical biotechnologies and how to deal with analysis models conducted in medical laboratories.

Curriculum CHEM343

1- Introduction to Clinical Biochemistry

Definition of clinical chemistry – Why do we study clinical chemistry – Collection and preservation of samples (blood – urine – stool) – Factors to be taken into account before collecting samples – Factors to be taken into account at the time of sample collection – Possible changes in blood samples and urine after collection

2- Carbohydrate metabolism

Control of glucose metabolism (insulin, glucacon, and other hormones) – Measurement of blood glucose and diuretic levels – Diabetes, its classification and types – Diabetes and ketone bodies – Abnormal metabolism in the liver during diabetes – Low blood glucose level

3- Fat metabolism

Introduction – Cholesterol – Triglycerides – Phosphorous lipids – Fatty acids – Cholesterol metabolism – Lipid metabolism disorders – Lipoprotein – Obesity – Atherosclerosis Angina and heart attack

4- Protein metabolism

Plasma proteins – Chemical and physical methods for measuring proteins – Immunological methods for measuring proteins – Resulting diseases Changes in plasma protein concentration – Aminoclobulins (structure and classification) – Iminoclobulin formation disorders – Protein metabolism disorders

5- Hormones

Mechanics of the action of hormones - thyroid hormones and their concentration in plasma - effects of increasing or decreasing thyroid secretions - growth hormones

CHEM351 / Principles of Industrial Chemistry: Industrial Chemistry is an undergraduate course in Chemistry. Industrial chemistry is the process of developing, improving, and controlling basic chemical processes used in industry to convert raw materials and precursors into commercial products beneficial to society. The Industrial Chemistry program provides a broad education in the field of chemistry.

Curriculum K 351

1- Foundations and economics of chemical manufacturing processes

Factors affecting capital costs – factors affecting production costs

2- Types of chemical manufacturing processes

Continuous Industrial Operations – Meal Industrial Operations

3- Intermittent Process Reactors

Gaseous – liquid, liquid-solid, gaseous - solid, including the presence of homogeneous catalysts, including the presence of heterogeneous catalysts - production and conversion outcome

4- Flow curves for industrial processes

5- Material balance

6- Chemical corrosion and ways to prevent it

Types of corrosion - corrosion theories - factors affecting corrosion - corrosion prevention - membrane protection - chemical prevention - electrochemical prevention - corrosion tests and methods of reducing corrosion

7- Industrial pollution

Industrial water pollution – types of industrial water pollutants – wastewater treatment processes

Industrial air pollution and methods of treatment

8- Industrial Water Treatment

Water sources for industry and water quality used in industry – methods of water treatment in industry

CHEM352 / Polymer Chemistry: This course aims to learn the general aspects of polymer chemistry, classifications and natural and synthetic types, as well as through this course the study of polymerization reactions of all kinds, including step-growth polymerization (condensation) and chain polymerization (addition) and clarify some chemical reactions that can be made on the polymer. This course covers not only basic aspects, but also advanced research and applications of polymers in materials science.

CHEM352

Chapter One:

1- General introduction - what is meant by polymer - history of polymer science - sources of polymers - natural polymers - prepared polymers.

2- Label polymers-

Simple filamentous polymers - Designation of polymers resulting from condensation or addition - Designation of condensation polymers - Designation of copolymers - Designation of randomly formed copolymers - Nomenclature of alternating copolymers - Nomenclature of grafted copolymers - Nomenclature of lumpy copolymers (mold) - General and commercial nomenclature - Chemical nomenclature according to IUPAC -

3- Factors determining the qualities of the polymer

Molecular weight of the polymer - nature of the molecular chain of the polymer - molecular forces

Chapter Two:

1- Types of polymers and their classification

A. Inorganic polymers B. Organic polymers C. Technological classification of polymers

1.Heat wrought polymers (plastics) 2. Thermally hardened polymers 3. Fiber 4. Elastic polymers (rubber)

2- Classification of polymers based on reactions leading to their formation

A. Old classification (additive polymers and condensation polymers) B. Modern classification:]1.Sequential growth polymerization (free radical polymerization, catonic polymerization, anionic polymerization and coordinate polymerization) 2. Step-polymerization [

Chapter Three

Polymerization processes and conditions

A. Homopolymerization: 1. Mass polymerization 2. Polymerization of solutions

B. Heterogeneous polymerization: 1. Polymerization in plankton 2. Polymerization in emulsions 3. Polymerization between the two surfaces of solution 4. Polymerization in gaseous phase 5. Deposition polymerization

Chapter Four

Important industrial polymers with step-growth

- Polyesters - General Introduction: A. Aliphatic filament polyesters B. Aromatic filament polyesters c. Branched and crosslinked polyesters D. Polyesters Non-carboxylic acids

Polyamides - Polyurea - Polyurethane - Phenol-formalhyde resins (Resol and Novolac) - Urea-formaldehyde resins - Melamine-formaldehyde resins

Chapter Five

Polymer properties, diagnosis and analysis - Physical properties of polymers: 1.Crystallization and melting point

2. Glass case and glass transition degree

CHEM353 / Petroleum Chemistry: The course aims to provide the students with information about crude oil and its derivatives, methods of evaluating the qualitative specifications of oil derivatives, and what are the most prominent chemical and physical processes that take place in refineries to produce the required oil derivatives in the markets, then know all types of petroleum products and their additives.

CHEM353

1- Oil

Introduction – Theories of the Origin of Oil – Chemical Composition of Oil

2- Chemical processes in oil refining

Thermal solution – Thermal catalytic solution – Hydrogen solution – Catalytic polymerization – Catalytic alkylation – Catalytic isomerization – Phastic structural transformation

3- Composition of crude oil and its derivatives

Specific weight – viscosity – degree of flash – degree of fire – degree of combustion – volatility – degree of inline – ash content – destruction – cetane count and cetane coefficient – degree of cloudiness – doctor's examination – degree of distillation – octane number – number of penetration – degree of spill

4- Refinery Products

Products with low boiling points – gasoline – naphtha and kerosene – diesel fuel – heating oils – diesel engine fuel

5- Petroleum classification

6- Crude Oil Processors

7- Petroleum Refining

Distillation of all kinds - solvent extraction - absorption and abstraction - adsorption and adsorption

CHEM 333/ Green Chemistry: Green chemistry began in the United States in 1990 after the Pollution Prevention Act was signed, which aimed to protect the

environment by reducing harmful emissions from the same source. Under the law, the United States Government has awarded grants for the development of chemical products through various institutes and universities to reduce the risks of these substances. The objectives of the grants provided for the production of chemicals that neutralize harmful substances, reduce pollution and develop alternatives to chemicals that lead to their extraction processes to pollute the environment have evolved. Green chemistry seeks to make chemistry an integrated science by reducing the pollution caused by the chemical industry important to the pharmaceutical, pharmaceutical, petroleum and plastic industries by preventing the formation of this pollution in the first place.

Vocabulary of the Green Chemistry Course (KM 333)

1- Overview of Green Chemistry

- **The main objectives of green chemistry**
- **The beginnings of green chemistry**
- **Sustainable Development and Green Chemistry**
- **The Twelve Principles of Green Chemistry**

2- The economy of corn

- **Waste Reduction and Corn Economy**
- **Efficiency of the atom for total reaction**
- **Sheldon scale and the economy of corn**
- **Some interactions of the natural atom economy**

3- Limit the use of materials

- **Control the use of stimuli**
- **Choosing the right protection groups**
- **Reducing the use of non-renewable raw materials**
- **Process intensification**

4- Reduce energy requirements

- **Some improvements in energy efficiency**
- **Alternative energy sources**
- **Energy generated from waste**

5- Reduce toxicity and reduce risk

- **Control of substances hazardous to health**
- **Toxicometry**
- **Lethal dose and lethal concentration test**
- **Hogg Westerner scale**
- **AMES Test**

6- Waste reduction

- **Health problems caused by waste**

- **Waste management and waste management hierarchy for non-hazardous materials**
- **Waste prevention and reuse**
- **Reduce waste**
- **Recycling**
- **Energy recovery from waste**
- **Waste disposal**

7- On-site waste treatment

- **Types of biological treatment plants**
- **Physical and physical treatment**
- **Chemical processing**
- **Bioremediation**

8- Motivation and green chemistry

- **Types of Motivation Reactions**
- **Heterogeneous catalysts**
- **Homogeneous catalysts**

9- Green solvents

- **Solvents and the need for alternative solvents in green chemistry**
- **Safety considerations and green standards of solvents**
- **Environmental characteristics theory, health and safety**
- **Life Cycle Assessment Theory**

Sources:

1. Green Chemistry: An Introductory Text
by Mike Lancaster
2. Green Chemistry and Processes
By Mukesh Doble
2. Handbook of Green Chemistry and Technology
by James Clark and Duncan Macquarrie

CHEM 302 / Nanochemistry: It is a course for the final stages as it is a very modern science where we now live in the nano-age. It is very important for its wide applications in all industrial, medical, agricultural, engineering and many other sciences. It focuses on introducing the student to the nature of manu and methods of preparing and diagnosing nanomaterials and their applications. It is also taught to students of preliminary and postgraduate studies due to its applied importance in scientific research and medical centers.

The syllabus of inorganic nanomaterials:

- **Introduction**
- **History**
- **Definition of nanoparticles, nanomaterials, nanoscale.**

Nanomaterials:

-Chemical and physical properties

-Surface area to volume

-Quantum effect

-Types of nanomaterials (zero dimension, one dimension 1D, 2D, 3D) with examples

- **Bottom –up**
- **Top-down**

-Preparation methods: (Redox reactions, Self-assembly and Sol gel)

- **Metal inorganic nanomaterials:**

Ag NPs

Au NPs

Cu NPs

There are NPs

Ru NPs

others

- **Metal oxide inorganic nanomaterials:**

TiO2, SiO2, CuO, ZnO NPs

Shape and size effect

- **The effect of the factors**
- **Characterization of NPs using:**

SEM

TEM

XRD

UV-Vis

- **The applications of NPs**

CHEM401 / Chemistry of transition elements: Know some of the characteristics of the elements of the three transition chains, their compounds, beliefs, methods of isolation and diagnosis, and use some of them as cofactors.

1- Introduction to the Chemistry of the Three Transition Elements

1-1- Periodic characteristics: electronic arrangement - melting and boiling points - winnowing - ionization potential - electronic affinity

1-2- Oxidative states: oxidative numbers of common and uncommon states - oxidation and reduction potential - electrode potential

2- Chemistry of the first transition series

2-1- Its existence in nature - estimation and methods of extraction and purification - extraction and purification of iron, copper and zinc

2-2- Its compounds and preparation

2-3- Their complexes and preparation

2-4- Interactions

3- Diagnosis of transition metal complexes

3-1- The importance of diagnosing it

3-2- Analytical and physical methods - accurate elemental analysis - electrical conductivity methods - qualitative and quantitative analysis - determination of isomers

3-3- Spectral methods – Visible and ultraviolet radiation – Infrared radiation – Mass spectroscopy – X-ray – Nuclear magnetic resonance – Permian electronic resonance – Photoactivation

4- Stability of transition metal complexes

4-1- Kinetic stability – inert and effective complexes

4-2- Thermodynamic stability

4-3- Factors affecting stability - the effect of metal ion - Ligand and other factors

5- Transition Elements as Catalysts – Overview

CH 402: Nanochemistry: Introducing the student to the concepts of inorganic nanomaterials because of their scientific importance, especially as we live in the nano-age.

CHEM402 / Selected Topics : Mechanics of Inorganic Reactions Number of Semester Units : 3

Curriculum CHEM402

1- Nature and quality of mechanical

1-1- Synthetic information

1-2- Reaction kinetics

1-3- Stability and idle / speed rate and mechanical

1-4- The extent to which the velocity rate and the velocity constant depend on the concentration and nature of the reactants

2- Substitution reactions for

2-1- Octhedral complexes

2-2- Tetrahedral complexes

2-3- Quadruple planar complexes

3- Redox reactions

3-1- E-Transition

3-2- Extra-Consistency Ball Interactions / Intra-Consistency Ball Interactions

3-3- Complementary and non-complementary reactions

3-4- Oxidative Addition Reactions

3-5- Oxidative Compensation Reactions

4- Catalytic reactions

5- EThe hydrogenation of alkenes

6- Polymerization of alkanes and alkenes

7- Hydroform reactions

CHEM403 / Chemistry of anhydrous solutions: The course aims at multiple concepts. The curriculum deals with topics related to anhydrous solvents and their role in chemical reactions and the characteristics and type of each solvent, and the curriculum also includes an explanation of acids and bases in anhydrous solvents and how to measure their strength. The curriculum also addresses an important topic in chemistry and related to the stability of reactant compounds and theoretically expected products that were said to be carried out reactions. The so-called acids, harsh and soft bases and in detail for all inorganic reactions.

Curriculum K403:

1- Chemistry in non-aqueous solvent

Common non-aqueous solvents , Amphoteric behavior, the coordination model , chemistry in liquid ammonia , ammunition reaction , ammonolysis reaction , metathesis reaction , acid-base reaction , metal-ammonia solution , liquid hydrogen fluoride , liquid sulfur dioxide , chemistry in ethanoic acid , liquid dinitrogen tetraoxide N_2O_4

2- Acid base chemistry

History, Major Acid , Base concepts , Arrhenius concepts, Bronsted-lowry concept , solvent system concept, Lewis concept, Frontier Orbitals and acid-base reactions , Hydrogen bonding , Electronic spectra (Including charge transfer)

3- Hard and soft acids and bases

Theory of hard and soft acids and bases , Quantitative mechanism

4- Acids and bases strength

Measurement of acid base interactions , thermodynamic measurements , proton affinity , acidity and bascity of binary hydrogen compounds , inductive effects , strength of oxy-acids , acidity of cations in aqueous solution , steric effects , solvation and acid-base strength , non-aqueous solvent and acid base strength , super acids

5- Polyoxo compounds formation

Polymerization of aqua ions to polycataions , ploy oxoanions , Hetrogeneous acid-base reaction

References

1- G. L Missler and D A Tarr " Inorganic chemistry " 3rd edition

2- D F Shiver , P Atkins and C H Langford 2nd edition " Inorganic chemistry". Chapter 5

CHEM416 / Organic diagnostics: Diagnosis of organic compounds by spectral methods such as infrared technology, proton nuclear magnetic resonance technique, ultraviolet and visible technology.

Curriculum C416:

1- Visible and UV spectroscopy
1-1- We present about electronic absorbents and their types
1-2- Simple chromophore aggregates, types of spectral displacements and variation of absorption intensity
1-3- Experimental rules for guessing absorption sites
1.3.1 Butadiene fashion like
1.3.2 Cycloid dienes
1-4- Carbonic chromophores and solvent effect
1-5- Uncompensated gasoline ring absorbers and compensation effect on absorption and solvent effect
2- Infrared spectroscopy
2-1- Different vibrations of particle bonds
2-2- The relationship of stretch vibration with the law of Hook
2-3- Harmonic and ultra vibration tone
2-4- Dual action exchange of vibrations
2-5- Representation of infrared spectra
2-6- The relationship of absorption intensity to dipole moment
2-7- The relationship of the angle of the bond with the verb tiadel, stretch type – stretch
2-8- Interchange Verb Type Bending – Bending
2-9- Interchangeable Verb Curvature Type – Stretch
2-10- Comprehensive survey of the sites of vibrational absorption of the bonds of the main classes of organic compounds and the interpretation of their spectra
3- NMR spectroscopy of protons
3-1- Introduction

3-2- Chemical displacement
3.2.1 Definition of chemical displacement and measurement of displacement and its relationship to frequency and field strength
3.2.2 Factors affecting chemical displacement
3.2.3 Dimagnetic blocking (induction effect)
3.2.4 Psychotropic effect
3.2.5 Paramagnetic effect
3.2.6 Vanderwaals effect

3-3- Double twirl - twirl (first degree approximation)
3.3.1 Definition of the phenomenon
3.3.2 Interpretation of the fission of Burm-Boram
3.3.3 Dual constant and simple fission pattern
3.3.4 Rules for guessing the fission pattern
3.3.5 Physical effects on twirl-twirl
3.3.6 Exchange phenomenon
3.3.7 Four-pole torque phenomenon
3.3.8 Review of the absorption sites and interpretations of different protons
3.3.9 Integration and calculation of the number of protons
3-4- Double twirl – twirl (second degree approximation)
3.4.1 Chemical equivalence and magnetic equivalence
3.4.2 Proton coding
3.4.3 Complex systems of fission patterns
3.4.3.1 AB system , displacement calculation and double constant
3.4.3.2 Descriptive presentation of different types of second-class systems AB2, ABX, AAXX, ABC, A2B2C3
3-5- Compensated gasoline
3.5.1 Allelic duplications
3.5.2 Couples between adjacent protons
3.5.3 Pairs between twin protons
3-6- Dewy and dystropic protons
3-7- Means of simplifying spectra
3.7.1 Increased magnetic field strength
3.7.2 Deuterium replacement
3.7.3 Irradiation to decouple
3.7.4 Solvent change
3.7.5 Use of displacement detectors

4- Mass spectroscopy
4-1- Introduction
4-2- Mass spectrometer
4-3- Some important rules
4.3.1 Nitrogen base
4.3.2 Pair electron rule
4-4- The relative abundance of some elements
4-5- calculate the number of carbon atoms,
4-6- Calculation of molecular formula

4-7- Semi-stable peak
4-8- Ionization and various fissions of chemical bonds
4-9- Fractionation rules
4-10- Interpret the characteristic packages of the main organic compound classes

CHEM426 / Radiation and Nuclear Chemistry: The student's knowledge of what nuclear chemistry is, its difference from general chemistry, the difference between unstable and stable radioactive elements, the types of radiation they emit, how to protect living organisms from radiation and their applications in the medical and industrial fields and in the field of nuclear weapons industry.

Curriculum C426:

1- Introduction

The origin and structure of atomic theory - the structure and construction of the atom - the structure of the nucleus, its mass and size

2- Nuclear Items

Nuclear properties – forces between nuclei – meson theory – elementary nuclear particles

3- Introduction to Radiochemistry

Radioactive elements and their types - Radiation and its types - Radiation and its physical and chemical effects

4- Ionizing radiation

Alpha Ray – Beta Ray – Gamma Rays

5- Nuclear decay

Nuclear Decay Laws – Measurement of Nuclear Decay – Nuclear Dissolution Schemes

6- half-life

Methods for measuring half-life

7- Life

Radiation balance

8- Nuclear accelerators and their types
9- Nuclear reactors and their types
10- Nuclear fuel and its types

Methods of enriching nuclear fuel – tranquilizers – control electrodes – cooling medium – protective casings

11- Reactors with fast neutrons
12- Nuclear reactions

Nuclear fission – nuclear fusion

13- Energy sources in nuclear reactors
14- Devices used for radiometry
15- Units of measurement of rays

Authorized doses – biological effects – radiation protection

16- Applications in Analytical Chemistry

Foundations of revitalization analysis - areas of use of activation analysis - peer-investigation analysis

17- Radioisotopes in physical chemistry
18- Study of the mechanics of chemical reactions

Fission Site Diagnosis – Chemical Bonds

CHEM427 / Liquid crystals: The course includes the subject of liquid crystals and their applied importance in the industrial and medical fields, it focuses mainly on understanding the basic principles of liquid crystals and their types (lyopy and thermotropics) depending on their chemical composition, which directly affects the emergence of their different phases and how to diagnose and identify them accurately. Liquid, which is considered one of the most important applications of this topic, and finally focus on the basic aspects of the use of these materials in pharmaceutical and medical applications.

Curriculum C427

1- Introduction – Definition of corrosion and causes of its occurrence

2- Purpose of the corrosion study

3- Factors affecting corrosion

4- Solution chemistry for corrosion

5- Important terms specific to corrosion

6- Types of erosion cells

7- Erosion treatment methods

Cathodic protection – anodic protection

8- Types of corrosion inhibitors

Organic inhibitors – Inorganic inhibitors – Coating

9- Corrosion measurement methods

Weight loss methods – polar method

CHEM431 / Chemistry of Instrumental Analysis: The course includes a detailed explanation of the basic principles of instrumental analysis, spectroscopy and various spectroscopy such as ultraviolet visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy in all its details, fluke and phosphorylation techniques.

Curriculum C431

1- Introduction – Photoanalysis Methods

1-1- Types of automated analysis methods

1-2- Electromagnetic spectrum – wave and particle nature of electromagnetic beam – absorption of rays – types of transitions

1-3- Chromotoro and oxocromium – red displacement – blue displacement – charge transfer absorption beams

2- Devices used in photoanalysis

2-1- Sources used in the ultraviolet zone – visible and infrared

2-2- Reagents – Cell Voltage – Photocell – Photomultiplier –

2-3- Filters and miscellaneers (uniform color) – filters – absorption filters – color units – diffraction grooved – prisms

3- UV and visible absorption

3-1- Radiation Absorption Laws

3-2- Bert-Lambert's Law – Absorbency Constant – Deviation from Beer's Law – Instrumentation Factors – Chemical Agents

3-3- Devices used to measure visible and ultraviolet rays

3-4- Applications

3-5- Mix Analysis – Symmetry Point – Molar Ratio Method – Continuous Variation Method

4- Fluorescence and phosphorylation

4-1- Introduction

4-2- Fluorescence and phosphorylation theory – the relationship of concentration with fluorescence intensity

4-3- Suppression

4-4- Used Devices & Applications

5- Infrared radiation

5-1- Preparation of the solid model of measurements – gases – liquids

5-2- Quantitative Analysis

5-3- Devices used

6- Flame atomic emission and absorption spectrum

6-1- Introduction

6-2- Types of flame and measurement of flame temperature – speed of gases

6-3- Fireplaces – types of stoves – pros and cons

6-4- Induced processes in flame

6-5- Methods of entering the model – liquid solid

6-6- Overlaps

6-7- Non-flame atomic absorption

6-8- Atomic emission spectroscopy in inductively coupled plasma plasma - Advantages of emission plasma - Use of plasma as a medium for ablation - Use of plasma in atomic telephoresis

6-9- Atomic fluorescence – types of flame atomic fluorescence – devices used – interventions

6-10- Devices used in technologies

CHEM444 / Selected Topics in Biochemistry: The teaching of this course aims to present some important topics in the field of biochemistry that clarify the relationship of chemistry to body functions and clarify the chemical variables that occur within the body.

Curriculum C444

Technologies for separation and isolation of large biomolecules

1- Leaf chromatography and thin layer

1-1- Rules and basics of chromatography
1-2- What is the chromatography of the leaf?
1-3- Moving phase and fluid flow
1-4- What is the thin layer
1-5- The mechanism of work and how to prepare the laminate
1-6- Applications of paper chromatography and thin sheets
2- Electrical migration
2-1- Fundamentals of electrical relay and working theory
2-2- Logical electrical relay
2-3- Free Electric Relay
2-4- Factors affecting the separation process
2-5- Electrical Migration Applications
3- Gel filtration
3-1- Types of gels and the most commonly used and common
3-2- Bulging process and column filling
3-3- The mechanism of separation and distribution of ranges inside and outside the gel
3-4- Quantification of models
3-5- Gel filtration chromatography applications
4- Liquid chromatography
4-1- High performance liquid chromatography
4-2- The basics of this technique
4-3- Why and to whom is this technology used
4-4- Chromatography of the inverse phase
5- Gas chromatography
5-1- Carrier gas specifications and features
5-2- Types of columns used
5-3- Detectors used to sensitize isolated materials
6- Ion exchange chromatography

6-1- Types of resins used
6-2- Method of separation and isolation of models
7- Extraction and purification of biological macromolecules using laboratory methods for the purpose of isolation and separation

CHEM455 / Polymer Manufacturing: The course aims to give a clear idea of what is meant by polymer manufacturing, which includes converting the polymer into a final product using one of the manufacturing methods, which depends on the quality of the polymer, whether it is a wrought or non-wrought polymer to heat, in addition to giving optimal conditions for the manufacturing process. On the other hand, from the practical side, the most important mechanical properties of polymers and methods of measuring them are addressed to give a clear idea of the polymer before using it in the place designated for it.

Curriculum C455

1- Introduction to the classification of polymers from a technological point of view

Plastics (thermoplastics) – thermally hardened resins – Rubber polymeric fibers – Polymeric compositions – Polymeric mixtures – Polymeric alloys – IPN interference network polymers

2- Streamlined properties of polymers - factors affecting them - how to adopt these characteristics in the manufacture of polymers

3- Polymer manufacturing techniques – molding of all kinds – extrusion – injection – vacuum forming – casting – polishing

4- Molds used in polymer manufacturing – study of the relationship between the geometry of the mold and the molecular orientation of polymeric chains

5- Molecular orientation of polymeric chains and its distribution in the mold and how to control molecular orientation – Parallel orientation of the drag axis – Orientation perpendicular to the drag axis – Double orientation of the axes

6- Mechanical properties of polymers and factors affecting them – structural factors and external factors such as heat, pressure and humidity – Additives

7- Devices and techniques used in the measurement and evaluation of mechanical properties

Tensile strength – Impact strength – Elastic modulus – Dynamic loss coefficient – Slip coefficient – Relaxation

8- Diagnosis of industrial and commercial polymers in order to benefit from recycling and reduce pollution

CHEM456 / Industrial distances: includes the definition of additives that are added to foodstuffs, oils and polymers, their types and the mechanism of their action.

Curriculum C456

CHEM461 / Industrial Pollution Chemistry: For the purpose of preserving the environment and natural resources in order to achieve health, well-being, sustainable development, spreading awareness and reducing industrial pollution that is destructive to the environment.

Curriculum C461

1- General introduction to pollution

A brief history of international concerns in the problem of pollution - definition of pollution - pollution control law - the basic components of nature and natural balance

2- air pollution

2-1- Air pollutants and their main sources - dust and its natural and industrial sources

2.2 Pollutant Units of Measurement – Control of Sources of Pollution by Industrial Dust

2-3 - sulfur oxides (sources, interactions, methods of controlling sources of pollution)

2-4 - carbon monoxide gas (sources, interactions, methods of controlling sources of pollution)

2-5 - nitrogen oxides (sources, interactions, methods of controlling sources of pollution)

2-6 - Hydrogen sulfide gas and methods of its removal

2-7-- Hydrocarbons and photooxidants (sources, interactions, methods of controlling sources of pollution)

2.8 Air allergens

2.9 Smoking

2.10 Stranosphere pollution

3- water pollution

3-1- Water pollution and its main sources

3-2- Crude oil water pollution

3-3- Water contamination with washing powder

3-4- Pesticide contamination of water

3-5- Water pollution with heavy metals (inorganic compounds)

3-6- Solid waste contamination and disposal methods

3-7- Water pollution by salinity

3-8- Thermal pollution