Jazan University

College of Science

Chemistry Department

CURRICULUM OVERVIEW AND STUDY PLAN

Bachelor of Science in Chemistry Program

قسم الكيمياء
CHEMISTRY DEPARTMENT

A small overview of the program& its general information, employment outlook, program learning outcomes, program structure & workload, and course syllabus

Jazan university
Faculty of sciences
Chemistry department
B. Sc. In Chemistry Program

https://www.jazanu.edu.sa/en/colleges/college-science/chem

https://goo.gl/maps/Equai1ZzaKy7GSeE8

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1. About the Program

1.1. Establishment.

The Chemistry Degree program at the Faculty of Science, JU was established in 2008 (Appendix 1.a) and (Appendix 1.b). The Bachelor program is taught in the Main campus (Boy as well as Girl sections) besides the Samtah University College branch.

The reason for establishments:

Chemistry is an incredibly fascinating field of study. Because it is so fundamental to our world, chemistry plays a role in everyone's lives and touches almost every aspect of our existence in some way. Chemistry is essential for meeting our basic needs of food, clothing, shelter, health, energy, and clean air, water, and soil. Chemical technologies enrich our quality of life in numerous ways by providing new solutions to problems in health, materials, and energy usage. Thus, studying chemistry is useful in preparing us for the real world.

Chemistry is often referred to as the central science because it joins together physics and mathematics, biology and medicine, and the earth and environmental sciences. Knowledge of the nature of chemicals and chemical processes therefore provides insights into a variety of physical and biological phenomena. Knowing something about chemistry is worthwhile because it provides an excellent basis for understanding the physical universe, we live in. For better or for worse, everything is chemical!

Economic Reasons

- National policy to provide society with trained and skilled Saudi national manpower.
- Improve local population opportunity for quality high-education

Social Reasons

- The Chemistry Program was not offered (before establishing this program) for local community stakeholders in Jazan area. -the nearest chemistry program was located 180 km in ABHA area-.
- provide society with scientific expertise.
- Provide society with generally skilled graduates to serve in occupations relevant to chemistry, petroleum, petrochemical, pharmaceutical, mining, food, detergents and other chemical industries.
- Improve the local youth population's chances for good job opportunities in chemistry-related establishments

1.2. Vision Statement.

The pursuit of excellence in education, scientific research, and community services.

1.3. Mission Statement.

Provide educational, and research services and build effective partnerships to serve the community in chemistry.

1.4. Goals and Objectives.

Goals

G 1. Provide comprehensive and optimal education based on the department and services.

G 2. Improving the department information technology structure.

G 3. Verifying the completion of the department annual plans and governance.

G 4. Improving the department capabilities of human resources.

G 5. Providing high-quality academic programs and provide a comprehensive and optimal education based on modern education strategies.

G 6. Encourage faculty members and students and engaging them in innovative and interdisciplinary research.

G 7. Creating and strengthening cooperation and partnerships and guiding students to take advantage of training opportunities from relevant authorities.

G 8. Improving and developing program learning outcomes and developing students' skills to suit the requirements of the labor market.

G 9. Improving the efficiency of the department graduates.

G 10. Providing services that meet the society and improve the quality of life.

The B.Sc. program is an entity within the College of Science. However, the mission and goals of the program were derived from the college mission and goals. The program aims to prepare qualified graduates outstanding in practice, scientific, and research on a high level of efficiency and able to meet the community's needs and keep up with the labor market requirements. The program runs under effective leadership that implements the policies and regulations in institutional systems. The program leadership plans, implements, monitors, and activates a quality assurance system that achieves continuous improvement of performance in a framework of integrity, transparency and within a supportive organizational environment. The program objectives are consistent with the faculty of science mission and in line with the JU mission as well.

The goals of the Bachelor in chemistry program are four items that are matched with the program objectives, the first- is institutional goals- we have four goals (G1-G4) that are inculcating the professional skills to function effectively in the work environment as well as the community is aligned to contribute as effective team members and managers in their organizations. The second item- internal operations- contains two goals (G5-G6) matched with providing high-quality education services and engaging students as well as staff members in innovative and interdisciplinary research. The third item is -resource goal- (G7) which deals with the creating and strengthening cooperation and partnerships and guiding students to take advantage of training opportunities from relevant authorities. The last item – stakeholders- contains three goals, (G8-G10), these attributes deal with improving and developing program learning outcomes and students' skills to suit the requirements of the labor market. It also enhances the efficiency of the department graduate and continues providing services that meet society's benefits and improve the quality of life.

Objectives

The main objectives of the program to fulfill the department seven goals are as follows;

O 1. To provide a comprehensive and optimal education based on high-quality educational strategies.

O 2. Training students to acquire the knowledge and professional competence necessary to work effectively to meet the requirements of the labor market.

O 3. Providing students with supportive means of learning practices and enhancing their personal skills that enable them to work successfully.

O 4. Engaging students in innovative and interdisciplinary research.

O 5. Provision of trained graduates equipped with values for serving the Kingdom.

O 6. Encouraging scientific research that contributes to meeting the requirements of development with wide economic and social benefits.

O 7. Creating strong links with the community and providing effective community Services

1.5. Values.

Citizenship:	Pride in the national identity and a sense of social responsibility.
loyalty:	a sense of commitment and initiative towards the goals and objectives of our department.
Responsibility:	Adherence to ethical standards and work values.
Excellence:	The application of standard practices and offering quality services.
Capacity Building:	Investing in human capital.
Teamwork:	Devoting the principle of cooperation and teamwork in the spirit of one team.

1.6. Degree Offered.

The awarded degree is a Bachelor of Science (B.Sc.) in Chemistry/ Faculty of Science/Jazan University (Appendix 1.a), (Appendix 1.b) and (Appendix 5). The system of Higher Education in Saudi requires at least 130 credit hours for a Bachelor's degree (equivalent to 229 ECTS credit points). The Jazan University regulates education to enable the student to complete his/her bachelor's degree in Chemistry in four years of full-time study (Appendix 6).

2. Program General Information

University	Jazan University (JU)
College	College of Science
Department	Chemistry
Name of the Degree Program	B. Sc. in Chemistry
Duration of Study	4 years (8 semesters)
Total Credit Points	130 CH (KSA) » 245.72 (ECTS)
Website of Jazan University	التميز التعليمي في المملكة العربية السعودية	جامعة جازانhttps://www.jazanu.edu.sa/ar / Arabic Excellence Education in the Kingdom of Saudi Arabia	Jazan University / English
Website of Faculty of Science	https://www.jazanu.edu.sa/ar/colleges/sci Arabic College of Science	Jazan University / English
Website of chemistry department	Chemistry Department	Jazan University
Program Started on	2008
Expected Number of Intake	240
Types of Fees	Free of charge
Office Contact Person	Head of the Department
Telephone	0173295516
Email	wmalamier@jazanu.edu.sa
Fax	
Postal Address	Department of Chemistry College of Science (University City Building) Jazan University Kingdom of Saudi Arabia Postal Code: Jazan 45142 P.O. Box 2097

2.1. Branches and Locations.

The Bachelor of Science in Chemistry program at Jazan university is offered on the main campus (boy and Girl sections) and in one branch (Female Branch Campus: College of Science and Arts- Samtah)

Campus	Place	Location
Main Campus- Boy	University City Building	https://goo.gl/maps/SQUyd2qCAqhmfvGVA
Main Campus- Girl	Mahlia Campus	https://goo.gl/maps/zPjYqZvCdd6V44sc6
Samtah branch	Samtah University collage	https://goo.gl/maps/CNjsBaMbLEeEnmfJ7

2.2 Teaching Facilities (Classes, Laboratories, Library, ……etc).

Classroom Supplies

In our department, the main campus (Goy & Girl) as well as the Samtah branch several classrooms are available for teaching. Each classroom is fitted with a white board, an overhead projector, writing pens, and dusters. and other classroom supplies are available from the academic departments. Also, there are several general classrooms in the college are available for general purposes to all departments.

Also, there are several study open places on all floors, computer rooms, a Sports activities Room, a Cafeteria, and a theater

Textbooks and Course Materials

Wherever necessary, a scheduled course has a designated textbook, which has been adopted by the department. As all students registered in a course will have a copy of this book, an instructor may freely refer to the textbook as and when necessary. The adoption of a textbook does not restrict the instructor to use this book exclusively in his teaching and therefore he may freely adopt other references to supplement teaching material, which may include his prepared lecture notes.

Where there is no designated textbook, an instructor must rely on his collection of materials and whenever necessary and appropriate, he should distribute the course materials to the students in his class. An instructor can propose a new textbook, either as a replacement for an existing one or as a new addition to a course where there is no designated textbook, by following the University`s procedure, which requires approval of the department, the college, and the University.

Teaching Laboratories

Multiple teaching laboratories serve students in all areas of chemistry, including introductory courses and courses in organic, inorganic, physical, analytical, and biochemistry. Our teaching labs are equipped with state-of-the-art instrumentation that students use regularly.

Equipment & Instrumentation

The department provides Labs with all necessary types of equipment, tools, safety aids, and chemicals for undergraduate study. We have excellent UV-absorption, modern atomic absorption, GC-MS, FTIR, flam photometers, HPLC instruments … etc.

Library

On the 2nd floor, the college library is there, this library contains books in sufficient numbers for all students in the college including chemistry students. Also, the central library in the university student may use beside the digital library of Saudi Arabia all students use their ID to enter its site
http://deanships.jazanu.edu.sa/_layouts/Authenticate.aspx?Source=/lib/Pages/sdl.aspx

2.3 Teaching Strategies.

We have a varied diet of assessments designed into our courses, ranging from time-constrained Examinations to mini-dissertations. A key element of the assessment methodology is the application of learning, and approaches that promote deep learning rather than shallow learning experiences,

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: Examinations, quizzes, homework assignments, laboratory write-ups, research papers, small group problem-solving of questions arising from the application of course concepts and concerns to experience, oral presentations, or maintenance of a personal lab manual…….etc.

Grades and competency will be determined according to the student's ability to demonstrate knowledge of specific chemistry topics and complete work by assigned deadlines; participate in and complete reports of assigned laboratory experiments; and an evaluation of the skills will be done by feedback, focus group, and survey

The verification of the results will be achieved by checking the grade, Exam, and test results by another instructor and head of the department. The QA committee compares the results with other courses in the same levels to obtain the courses with grade shifts.

Also visiting some factories and research centers, participating in activities inside our department or at the university, attending workshops, …etc. will help our students to acquire more and more experiences

According to the PLOs we have designed the following table lie PLO with the suitable strategies and assessment methods. Teachers feal free to use the suitable strategies

Program learning Outcomes PLOs Code		teaching strategies	Assessment Methods
K	**Knowledge& understanding :Upon completion of the program, students are able to:**	**Knowledge**	**Knowledge**
K.1	*Demonstrate a broad understanding and critical view of the principal theories, concepts and terminology of chemistry area or field of work, and in addition the necessary background in Physics and Mathematics*	*lecture / group work discussion / project-based learning / Seminars / Internship in industry / work shop / brainstorming / individual presentation / case studies / role playing / individual presentation*	*oral and written examinations (Scheduled and surprise tests) / Closed-book and open-book tests /Paper pencil test (Objective Type or/ and Subjective type) /presentations / Practical assignments and laboratory reports*
K.2	*Describe correctly Chemical phenomena using chemical principles and scientific reasoning*	*lecture / group work discussion / project-based learning / Seminars / Internship in industry / work shop / brainstorming / individual presentation / case studies / role playing / individual presentation*	*oral and written examinations (Scheduled and surprise tests) / Closed-book and open-book tests /Paper pencil test (Objective Type or/ and Subjective type) /presentations / Practical assignments and laboratory reports*
S	**Skills:Upon completion of the program, students are able to:**	**Skills**	**Skills**
S.1	*Demonstrate an ability in critical thinking, numeracy, statistical, analytical reasoning, use graphs, charts for solving problems (in the synthesis, measurement, and modeling of chemical systems),*	*lecture / group work discussion / project-based learning / Seminars / Internship in industry / work shop / brainstorming / individual presentation / case studies / role playing / individual presentation*	*Problem-solving exercises / Closed-book and open-book tests /Paper pencil test (Objective Type or/ and Subjective type) /*
S.2	*Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments in various fields of chemistry and to write a report representing the scientific data.*	*lab demonstrations /hands-on student learning activities / whole group and small group discussion / project-based learning / Internship in industry*	*Practical assignments and laboratory reports / Individual and group project reports*
S.3	*Examine his material and lab safety background to Follow proper procedures and regulations for safe handling and use of chemicals.*	*lab demonstrations / hands-on student learning activities / internship in industry*	*Observation of practical skills / Safety exam / Practical assignments and laboratory reports*
S.4	*make effective use of communication, and online technology about chemistry topics in order to improve their basic knowledge in writing (report and paper/ poster) with a good verbal and clear scientific language.*	*research activities / project-based learning / Technology-enabled learning*	*assignments and reports / project / seminar / report*
V	*Values , Autonomy and Responsibility: Upon completion of the program, students are able to:*	Values , Autonomy and Responsibility: Upon completion of the program, students are able to:	Values , Autonomy and Responsibility: Upon completion of the program, students are able to:
V.1	*Work as a group leader in cooperation with other colleagues*	*lab demonstrations /hands-on student learning activities / whole group and small group discussion / project-based learning / Internship in industry*	*group project reports / Practical assignments and laboratory reports /*
V.2	*Perceive the ethical and social dimensions of practicing chemistry or any related field.*	*research activities / project-based learning / Technology-enabled learning / group work discussion*	*Viva voce interviews assessment methods*

2.4 Other Facilities (IT, Students Campus Facilities, etc…).

Information Technology

The Deanship of E-learning and Distance Education at Jazan University is responsible for providing integrated administrative and educational e-services for all stakeholders at the university. These customized services are provided for the teaching Staff, Students, and employees of the university through the University website and mobile applications that can be accessed with a dedicated ID and password.

Students Campus Facilities

The Department ensures all necessary and sufficient Equipment for all stakeholders in the department. Some general facilities are provided by the college of science such as a cafeteria, Mosque, book store, library, gym, and indoor games for exertion. The VPN network and Wi-Fi internet are available for all employees and students in the faculty of science building. These facilities are comparable with other faculty programs at any university inside the Kingdom.

Also, Medical facilities are available; Inside each Lab and other places, first aid boxes are available for emergencies. in the college, we have a medical room. University Hospital is also available, https://goo.gl/maps/yAu87YwZY63e4SxE9 . Near our campus, there is a medical center of Prince Mohammed bin Nasser Hospital, https://goo.gl/maps/s8vFycvVBWK3YvXPA .

2.5 Student Advising Policy.

Academic advising is a key to success at any higher education institution. Our department considers academic advisers a valuable resource to students as they help plan their undergraduate careers and, ultimately, prepare them for graduation. Academic advising means guiding the students/advisees on different issues related to their academic progress and helping them find solutions to different academic problems. Academic advising is related to assisting students with educational choices, degree requirements, academic policies/procedures, as well as broader concerns such as career and graduate school options in the future.
The Four "4" Stakeholders involved in the process of Academic advising at the Chemistry Department, Faculty of science, Jazan University are:

- The Advisee / Students.
- The advisor / Faculty Member (Role Played as Academic Advisor or Career Advisor).
- The Head of the Academic Advising Committee or the Head Academic Advisor.
- And the Department / Program.

Each student in the chemistry program has an academic advisor whose job is to provide students with consultation and academic support mainly during registration time but also any time during the semester.

Students may consult their advisor, as well as the Department Chair and the Dean of the College, for any issues or concerns concerning their academic life. Given the number of chemistry students, the students are divided among the college for advising. The process is as follows;

- Student Academic Counselling Committee is in charge of student counseling.
- Each Faculty is assigned a group of students for counseling.
- Faculty will be available for student counseling at specific office hours daily.
- Faculty should make a file for each student in his counseling group where student contact information, a copy of the student timetable, and a copy of the student's academic record are kept and updated every semester
- The rules, regulations, and responsibilities may be described in detail in the department manual.

Academic advisor tasks

- Performing the plans and programs of the College's Guidance Unit and the University's Academic and Student Guidance Center.
- Coordinate with the head or coordinator of the department and the Academic and Student Guidance Unit in the college to accomplish his tasks.
- Prepare a folder for each student assigned to be supervised. This folder should contain the following: (student's data, study plan, academic record, guidance forms approved by the University's Academic Guidance Center, Communication process with the student, Individual and group guidance forms)

- Hold meetings with students at the beginning of a semester and throughout the school year and enlighten them on the importance of guidance hours. Also, demonstrate a sincere desire to help them.
- Introduce the University's regulations to the guided students, especially those related to the Exams, study and disciplinary regulations, and other matters of interest to the student.
- Motivate the guided students to respect all registration, deletions, additions, withdrawals, etc operations on the portal according to the dates announced by the Deanship of Admission and Registration.
- Ensuring that the student registers in the required courses for the required hours according to his GPA and his study plan.
- Inform the guided students about the courses which have previous requirements in the study plan.
- Inform students who are guided by e-courses, combined courses, and traditional courses included in their timetable.
- Introduce the university calendar to the guided students and ensure that they have received their timetable on the portal.
- Ensuring that the guided students know the classrooms' location, the instructors who will give them the courses, and their academic numbers.
- Motivate the guided students to attend lectures, abide by the university regulations, and listen to their problems and suggestions.
- Helping students adapt to their specialization, especially the new students, and working to overcome the obstacles and problems that are facing them.
- Respond to student questions via Blackboard or social media about course registration, course selection, deleting and adding courses, absence of the student, and withdrawal from the university ... If the student has a GPA less than 2.00, he will be warned in the first time. The advisor should explain to the student what are the consequences of this result.
- Make attention to stumbling students, intensify communication with them motivate them to improve their academic situation, and help them to solve the problems that prevent their progress.
- Methods that the advisor should perform with the stumbling student
- The advisor should contact the student by phone or e-mail to make an appointment with him.
- At the beginning of the meeting, which should take 30-60 minutes, the advisor explains to the student that the meeting's purpose is to help him to go out of the stumbling in the study.
- The advisor tries to know the psychology of the student and the reasons behind his poor performance.
- When the advisor knows the real reason, he begins to develop a plan for the student with cooperation and coordination with the teachers of his courses.
- Reviewing someone other than the advisor can be part of the plan.
- Arrange a calendar for appointments with the student who has received warnings, follow them seriously, and record those meetings in the student's guidance file.
- The advisor continues to encourage his student and infuse the spirit of determination in his soul. This relationship between the student and the advisor will motivate the student continuously to make a greater effort when he feels that there is someone who trusts his ability.
- Make attention to the excellent students and encourage them to continue their progress and help them to solve their problems.
- Knowing the talented students, work to encourage them to develop their talents and guide them to communicate with the relevant authorities and organisms related to student affairs and the Academic and Student Guidance Center.
- gathering information about the students who have scholarships and attention to their affairs and problems and directing them to communicate with the relevant bodies of student affairs and the Academic and Student Guidance Center.
- Provide students with scientific information and guidance related to some of the skills that can help them in the development of their skills such as study skills, tests, time management, etc., and direct them to the websites where they can get information about these skills, and the distribution of manuals and guides printed by Unit and Center).

Also, our university has different clubs to improve the social and career of students as:

- Science Club, Scout Club, Computer Science Club, Society Partnership Club, Club of Culture and Dialogue, Literary Club, Club Theater, Al-Falcour Club, Al Jawala, Health Club, Friends of the Environment, Photography Club, Club Reading Arts, Arts Club, …etc

2.6 Attendance and Exam Policies.

Students can join the program after passing the preparatory year. The College Council annually determines the number of students who can be admitted to the program based on the Department capacity and the student GPA in the preparatory year. A student must meet the following requirements for admission to the university:

1. Hold a high school or equivalent degree from a college in Saudi Arabia or an equivalent institute out of the Kingdom.
2. The high school degree must have been issued in the last five years for full-time students. The University Rector has the authority to give exceptions to this rule on a case-to-case basis.
3. A student must be of good conduct and behavior.
4. Students must pass any additional test or interview that might be required by the university.
5. Students must be medically fit to study at the university.
6. In the case of a student working in a government or private sector, he must obtain permission to study from his employer.
7. A student should satisfy any other conditions determined by the University Council during the application assessment.
8. A student who has been dismissed from any other university is not eligible for admission.
9. Those who already have obtained a Bachelor's Degree or its equivalent shall not be admitted to obtain another Bachelor's degree. The University Rector has the right for exception to this rule on a case-to-case basis.
10. A student who is already registered for an academic degree at Jazan University or any other university is not allowed to register for another degree.
11. The student must be medically fit.

To join the Bachelor of Science in Chemistry Program, an applicant must: Hold a Saudi High School Certificate in Science Section (or its equivalent), with a grade 70% for both boy and girl

3. Employment Outlook

A person working as a Chemist in Saudi Arabia typically earns around 32,900 SAR per month. Salaries range from 16,100 SAR (lowest) to 51,300 SAR (highest).

This is the average monthly salary including housing, transport, and other benefits. Chemist salaries vary drastically based on experience, skills, gender, or location. Below you will find a detailed breakdown based on many different criteria.

http://www.salaryexplorer.com/salary-survey.php?loc=191&loctype=1&job=678&jobtype=3

3.1 Program Graduates Attributes.

According to the attributes and characteristics of graduates at Jazan University, the chemistry department put suitable learning outcomes to fit these attributes which are;

- Passion for knowledge, continuous researh, and practical application of knowledge
- The ability to solve problems and make decisions
- Commitment to values, morals, and responsibility
- Digital communication
- Effective Communication and Negotiation
- Leadership, leadership, and teamwork
- professional scientific conduct

These attributes enable our graduate to the following positions; according to Professions and jobs in the Ministry of Civil Service and Saudi National Commission:

https://eservices.mcs.gov.sa/ClassificationGuide/Pages/Degrees.aspx

- *Assistant researcher in chemistry*

This series includes the tasks related to the specialized works in the field of setting standards and requirements for goods and products and their basic components, including the Examination of measuring instruments and calibration by standard devices to ensure that they perform their work accurately and do other work that related to this area.

- *Assistant laboratory researcher in chemistry*

This series includes the functions related to the work of the chemistry labs in the preparation of research, studies, reports, and the use of instruments and devices for the analysis, Examinations, and chemical or physical composition of the materials, elements, samples, and other related works in this field.

- *Laboratory Analyst*

This series includes functions related to the work of laboratories and the use of instruments and equipment for the conduct of analyzes, tests, and chemical or physical formulations of materials, elements, samples, and other related activities in this field.

- *Laboratory Technician*

This series includes the functions related to the works of technical assistance for the conduct of analyzes or chemical structures, etc., and the subsequent results, the preparation of reports, and supervision of these works and other related work in this area.

- *Environmental Protection Specialist*

in the Field of Chemistry This series includes the functions related to the work of environmental protection from the preparation of researches, studies, reports, the use of machines and equipment and conducting experiments and analyzes to identify the extent of pollution of water, air, soil and the level of hazardous wastes including radioactive waste and the level of natural radioactive materials such Radium, Uranium and Thorium chains as well as the level of radiation in the waste of mines and radioactive waste generated by hospitals and some industries and research centers also include the preparation of studies and research and make recommendations in the light of information and data and The activities related to protecting the environment from waste from mines, quarries and hospitals, analyzing the level of these wastes, finding the appropriate safety and safety means to protect the environment and implementing the specific safety regulations for this area and carrying out other works. Related to this area)

- *Environmental Chemical Foreman*

This series includes functions related to the environment from the control and recording of hazardous waste data, air and water pollution, environmental degradation, use of instruments, devices, and radiological reagents, fieldwork of sampling and information collection, preparation of descriptive reports, technical supervision of these works and other related works the field)

- *Chemical safety and security*

This series includes the functions related to the preparation of planning and organizational studies to develop plans and programs and chemical safety instructions for public and private buildings and facilities and to ensure the safety and suitability of safety equipment and guidance and guidance and discovery of waste in the area of safety and safety of the work environment and the preparation of reports and recommendations and technical Safety and other related activities).

- *Chemotherapy Specialist*

This series includes functions that belong to the chemical processing of documents, archives, and manuscripts, sterilization, removal of contaminated spots for paper and leather, and technical supervision of these related works). Chemical Monuments Technician- (This series includes the functions related to the technical works in the field of prospecting and the search for antiquities and the subsequent works of restoration, maintenance, documentation, supervision of these works, and other related works).

3.2 Program Graduates and University Graduates attributes.

Program attributes	University attributes
Seeking knowledge, continuous research, and practical application of knowledge	Passion for knowledge, continuous research and practical application of knowledge
The ability to solve problems and make decisions	The ability to solve problems and make decision
Commitment to values, morals, and responsibility	Commitment to values, morals and responsibility
Digital communication	Digital communication
Effective Communication	Effective Communication and Negotiation
Leadership and teamwork	Leadership, leadership and teamwork
professional scientific conduct	professional scientific conduct

4. Learning Outcomes.

A learning outcome is a concise statement that explains what students should do or do after a certain amount of time has passed. Knowledge, skills, abilities, or values should be used to assess learning outcomes. The learning objectives place a greater emphasis on student performance than on traditional methodologies or courses.

However, the word "Learning Outcomes" can be defined in a broader sense as an aggregation of a learner's knowledge, skill set, and ability to apply them in real-world settings. SOLO (Structure of Observed Learning Outcomes), Bloom's Taxonomy, Fink's Taxonomy, and Wiggins and McTighe's Taxonomy are some of the taxonomies used in education. An ideal learning result would be something that adheres to all components of Bloom's Taxonomy since it encourages individuals to enhance their knowledge and skills and makes them life-long learners.

4.1 Program Learning Outcomes (PLO's).

Knowledge and understanding Upon completion of the program, students are able to:	
K1	Demonstrate a broad understanding and critical view of the principal theories, concepts and terminology of chemistry area or field of work, and in addition the necessary background in Physics and Mathematics
K2	Describe correctly Chemical phenomena using chemical principles and scientific reasoning
Skills Upon completion of the program, students are able to:	
S1	Demonstrate an ability in critical thinking, numeracy, statistical, analytical reasoning, use graphs, charts for solving problems (in the synthesis, measurement, and modeling of chemical systems),
S2	Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments in various fields of chemistry and to write a report representing the scientific data.
S3	Examine his material and lab safety background to Follow proper procedures and regulations for safe handling and use of chemicals.
S4	make effective use of communication, and online technology about chemistry topics in order to improve their basic knowledge in writing (report and paper) with a good verbal and clear scientific language.
Values, Autonomy and Responsibility Upon completion of the program, students are able to:	
V1	Work as a group leader in cooperation with other colleagues
V2	Perceive the ethical and social dimensions of practicing chemistry or any related field.

4.2 Consistency of PLO's with the University Learning Outcomes.

University → / *Program↓*	*Assessment of sufficient knowledge to analyze and clarify theories, principles, skills and practices in various disciplines*	*Demonstrate the leadership qualities and skills necessary in effective negotiation with others, orally and in writing, in a sound language*	*Commitment to professional and ethical behaviors and showing team spirit*	*Apply innovative independent and critical thinking to solve complex problems*	*Applying sustainable learning skills in all scientific and societal aspects with regard to environmental, economic and social issues*	*Effectively apply the skills and ethics of scientific research, innovation and creativity*	*Apply knowledge by masterfully accomplishing*
Demonstrate a broad understanding and critical view of the principal theories, concepts and terminology of chemistry area or field of work, and in addition the necessary background in Physics and Mathematics	☑						
Describe correctly Chemical phenomena using chemical principles and scientific reasoning	☑						
Demonstrate an ability in critical thinking, numeracy, statistical, and analytical reasoning, use graphs, and charts for solving problems (in the synthesis, measurement, and modeling of chemical systems),				☑			
Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments in various fields of chemistry and to write a report representing the scientific data.							☑
Examine his material and lab safety background to Follow proper procedures and regulations for safe handling and use of chemicals.			☑				
make effective use of communication, and online technology about chemistry topics in order to improve their basic knowledge in writing (report and paper) with a good verbal and clear scientific language.		☑			☑		
Work as a group leader in cooperation with other colleagues			☑				
Perceive the ethical and social dimensions of practicing chemistry or any related field.			☑			☑	

5. Program Structural and workload

The Bachelor of Science in Chemistry program is designed for the student who intends to become a professional chemist. The curriculum for this degree consists of a selection of rigorous chemistry courses as well as supporting courses in related areas of physical science and mathematics. This curriculum meets the standards set for certification by the National Qualification Framework, NQF, of Saudi Arabia.

The Bachelor of Science in Chemistry program is designed to provide students with an excellent foundation in chemistry. It equips them with the necessary laboratory skills and scientific training needed in the competent practice of the chemistry profession. Lectures, seminars, and laboratory classes are geared toward problem evaluation and decision-making. Courses in the humanities and social sciences are integrated to provide the perspective that will direct scientific efforts toward national concerns. The new curriculum has been designed to offer a stronger preparation for the professional chemist licensure Examination.

The curriculum offers a thorough fundamental knowledge of the major fields of chemistry, covering the general areas of inorganic, organic, analytical, and physical chemistry, plus many more specialized courses including analytical, nuclear, and chemical biology. Students gain laboratory experience in inorganic and organic synthesis, analytical methods, physical-chemical measurements, spectroscopy, and biochemistry. Undergraduates are encouraged to take full advantage of the scientific opportunities available in the department by joining a research group.

5.1 General View (total hours and list of requirements).

The B.Sc. degree in KSA is considered as a way to M.Sc., introducing students to scientific thinking and methods. The B.Sc. degree starts with general studies, e.g., Mathematics and Physics, the portion of which is significant in the first study year, the B.Sc. degree in chemistry consists of

https://drive.google.com/drive/folders/1_59BBH9X-Bk145iNxwLaUWn9FdzhySXa?usp=sharing

5.2 European Credit Transfer and Accumulation System (ECTS) Credits

ECTS is a standard for comparing the study attainment and performance of students across the European Higher Education Area (EHEA) and making studies and courses more transparent. It helps students to move between countries and to have their academic qualifications and study periods abroad recognized.

ECTS credits express the volume of learning based on the defined learning outcomes and their associated workload. 60 ECTS credits are allocated to the learning outcomes and associated workload of a full-time academic year or its equivalent, which normally comprises several educational components to which credits (based on the learning outcomes and workload) are allocated. ECTS credits are generally expressed in whole numbers.

The workload is an estimation of the time the individual typically needs to complete all learning activities such as lectures, seminars, projects, practical work, work placements, and individual study required to achieve the defined learning outcomes in formal learning environments. The correspondence of the full-time workload of an academic year to 60 credits is often formalized by national legal provisions. In most cases, the workload ranges from 1,500 to 1,800 hours for an academic year, which means that one credit corresponds to 25 to 30 hours of work. It should be recognized that this represents the typical workload and that for individual students the actual time to achieve the learning outcomes will vary.

Awarding credits in ECTS is the act of formally granting students and other learners the credits that are assigned to the qualification and/or its components if they achieve the defined learning outcomes. National authorities should indicate which institutions have the right to award ECTS

Accumulation of credits in ECTS is the process of collecting credits awarded for achieving the learning outcomes of educational components in formal contexts and for other learning activities carried out in informal and non-formal contexts. A student can accumulate credits to:

- Obtain qualifications, as required by the degree-awarding institution;
- Document personal achievements for lifelong learning purposes.

Approach to Allocating Credit in Science Programs

1. The teaching staff outlines the learning activities and calculates the expected workload required for a student to complete these tasks based on the learning outcomes of each program component. A work estimate is stated in credits, and proposals are gathered, Examined, and combined.
2. Faculty may decide from the start to standardize the size of educational components, giving each one the same credit value.
3. Taking into account that each ECTS credit is equivalent to 28 study hours on average.

Self-Learning Calculation

For University Requirements

ECTS for all university requirement courses were calculated **based on the opinion of students through survey** and found to be consistent with standard ECTS calculation equations as

$$No.of\ ECTS\ points = \frac{\text{credit unit} \times 60\ (\text{ECTS for 2 Semesters}) \times 4\ \text{years}}{130\ (\text{total credit of the program}}$$

For Program Requirements

1. Each CH will be multiplied by 15 (the official week number of a semester) to get the contact Hours
2. Every contact Hour is considered 50 Min as per the University rule
3. For all program courses, it has been found through surveying students' opinions that each Contact Hour requires a minimum of two Learning Hours.
4. Add all together the contact hours with preparation times for Exam, HWs, lab reporting and case studies, etc. to get the total Hours of Learning that the student spend for the course
5. Divide the learning hours by 28 to get the ECTS points:

$$\text{Equivalent ECTS points} = \frac{\text{Total LH}}{28}$$

5.3 Requirements (Course list, Credit hours/week, and Actual hours/week).

Table 1: requirements in the curriculum

Program Structure	Required/ Elective	No. of courses Hours	Credit	workload	ECTS	Percentage
Institution Requirements	Compulsory	7	18	939.6	33.3	14%
College Requirements	Compulsory	6	21	1066.4	38.09	16%
Program Requirements	Compulsory	30	89	4748.71	170.33	68%
Capstone Course/Project	Compulsory	1	2	144.17	4	2%
Field Experience/ Internship	not applicable	0	0	0	0	0%
Total		**44**	**130**	**6898.88**	**245.72**	**%100**

5.4 University Requirements (Course list, Credit hours/week, and Actual hours/week).

Table 2: university requirements in the curriculum

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Contact Hours		Total Credit Hours	workload	ECTS
					Lecture	Pract.			
1	101SLM 2	Islamic Culture I	R		2	0	2	103.6	3.7
1	105ENGL-6	Intensive Course in English Language	R		12	3	6	310.8	11.1
2	102SLM-2	Islamic Culture II	R		2	0	2	103.6	3.7
2	101ARB-2	Arabic Language Skills	R		2	0	2	103.6	3.7
3	102ARB-2	Arabic Writing	R		2	0	2	103.6	3.7
3	103SLM-2	Islamic culture III	R		2	0	2	103.6	3.7
4	104SLM-2	Islamic Culture IV	R		2	0	2	110.8	3.7
Total					24	3	18	939.6	33.3

5.5 Faculty Requirements (Course list, Credit hours/week, and Actual hours/week).

Table 3: Faculty requirements in the curriculum

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Contact Hours		Total Credit Hours	workload	ECTS
					Lecture	Pract.			
1	101BIO-4	General Biology	R		3	2	4	207.2	7.4
1	101MATH-3	General Mathematics	R		3	0	3	154	5.5
1	101CSC-3	Introduction to Computer.	R		2	2	3	154	5.5
2	101PHYS-4	General Physics	R		3	2	4	207.2	7.4
2	101CHEM-4	General Chemistry	R		3	2	4	190.00	6.79
2	106ENGL-3	English for Science	R	105ENGL	3	0	3	154	5.5
Total					17	8	21	1066.4	38.09

5.5 Program Requirements (Course list, Credit hours/week, and Actual hours/week).

Table 4: Program requirements in the curriculum

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Contact Hours		Total Credit Hours	workload	ECTS
					Lecture	Pract.			
Level 3	201MATH-3	Calculus	R		3	0	3	154	5.5
Level 3	231CHEM-3	Aliphatic organic Chemistry	R		2	2	3	152.00	5.45
Level 3	211CHEM-3	Volumetric Analytical Chemistry	R		2	2	3	155.67	5.56
Level 3	201CHEM-4	General and Physical Chemistry	R	101CHEM	3	2	4	206.17	7.36
Level 4	202MATH-3	Differential Equations	R	201MATH	3	0	3	166.2	5.5
Level 4	212CHEM-3	Chemistry of Gravimetric Analysis	R		2	2	3	170.00	6.07
Level 4	221CHEM-4	Chemistry of Main Groups	R		3	2	4	221.67	7.92
Level 4	232CHEM-3	Aromatic Organic Chemistry	R	231CHEM	2	2	3	152.50	5.45
Level 4	241CHEM-3	Thermodynamics	R		2	2	3	151.67	5.42
Level 5	313CHEM-3	Chromatographic Analysis	R		2	2	3	151.00	5.39
Level 5	322CHEM-4	Chemistry of Transition Elements	R	221CHEM	3	2	4	212.50	7.59
Level 5	333CHEM-3	Heterocyclic Organic Chemistry	R		2	2	3	175.33	6.26
Level 5	342CHEM-3	Kinetic Chemistry	R		2	2	3	174.00	6.21
Level 5	343CHEM-3	Surface Chemistry & Catalysis	R		3	0	3	159.17	5.68
Level 6	314CHEM-3	Electrochemical analysis methods	R		2	2	3	174.17	6.22
Level 6	323CHEM-3	Co-ordination Chemistry	R	322CHEM	2	2	3	150.50	5.38
Level 6	334CHEM-2	Spectroscopy of Organic Compounds	R		2	0	2	110.83	3.96
Level 6	335CHEM-3	Organic Reaction Mechanisms	R		2	2	3	153.33	5.48
Level 6	344CHEM-3	Electrochemistry	R		2	2	3	159.83	5.71
Level 7	436CHEM-3	Chemistry of Natural Products	R		2	2	3	156.00	5.57
Level 7	437CHEM-2	Stereochemistry	R		2	0	2	108.33	3.87
Level 7	445CHEM-3	Solution Chemistry	R		2	2	3	165.00	5.89
Level 7	446CHEM-2	Polymer Chemistry	R		2	0	2	93.33	3.33
Level 7	447 CHEM-3	Quantum Chemistry	R	202MATH	3	0	3	164.17	5.86
Level 7	491CHEM-2	Graduation Project	R	Dep. Approval	1	2	2	144.17	5.15
Level 8	415CHEM-4	Methods of Instrumental Analysis	R	314CHEM	3	2	4	211.67	7.56
Level 8	424 CHEM-3	Lanthanides & Actinides	R	323CHEM	2	2	3	149.33	5.33
Level 8	425CHEM-2	Group Theory	R		2	0	2	107.50	3.84
Level 8	438CHEM-3	Organic applied chemistry	R		2	2	3	163.33	5.83
Level 8	439CHEM-3	Principles of Biochemistry	R		2	2	3	162.83	5.82
Level 8	448CHEM-2	Photochemistry	R		2	0	2	116.67	4.17
				Total	69	44	91	5215.25	174.33

5.6 Courses and Program Learning Outcomes Mapping.

Table 5: Courses and Program Learning Outcomes Mapping

Level	Course code & No.	Program Learning Outcomes (PLOs)							
		Knowledge and understanding		Skills				Values, Autonomy and Responsibility	
		K1	K2	S1	S2	S3	S4	V1	V2
Level 1	101SLM 2								I
	105ENGL-6						I		
	101BIO-4	I	I		I	I			
	101MATH-3								
	101CSC-3								
Level 2	102SLM-2								I
	101ARB-2								I
	101PHYS-4	I	I	I	I				
	101CHEM-4	I	I	I	I	I		I	
	106ENGL-3						I		
Level 3	102ARB-2								P
	103SLM-2								P
	201MATH-3			I					
	231CHEM-3	I	I	I	I	I		I	
	211CHEM-3	I	I	I	I	I		I	
	201CHEM-4	I	I	I	I	I		I	
Level 4	104ISLM-2								P
	202MATH-3			I					
	212CHEM-3	I	I	I	I	I		I	
	221CHEM-4	I	I	I	I	I		I	
	232CHEM-3	I	I	I	I	I		I	
	241CHEM-3	I	I	I	I	I		I	
Level 5	104ISLM-2	P	P	P	P	I	I	I	
	202MATH-3	P	P	P	P	I	I	I	
	212CHEM-3	P	P	P	P	I	I	I	
	221CHEM-4	P	P	P	P	I	I	I	
	232CHEM-3	P	P	P			I		
Level 6	314CHEM-3	P	P	P	P	P	I	P	
	323CHEM-3	P	P	P	P	P	I	P	
	334CHEM-2	P	P	P			I		
	335CHEM-3	P	P	P	P	P	I	P	
	344CHEM-3	P	P	P	P	P	I	P	
Level 7	436CHEM-3	M	M*	P	M	*P*	I	P	
	437CHEM-2	M	M	P			I		
	445CHEM-3	M	M	P	M*	*P*	M	M*	
	446CHEM-2	M*	M	M			P		
	447 CHEM-3	M	M	M*			P		
	491CHEM-2	M	M	M	M	*M**	M*		M*
Level 8	415CHEM-4	M	M	M	M*	*M*	M	M*	
	424 CHEM-3	M*	M	M	M	*M*	M	M	
	425CHEM-2	M	M*	M			M		
	438CHEM-3	M	M	M	M	*M*	M*	M	
	439CHEM-3	M	M	M	M	M*	M	M	
	448CHEM-2	M	M	M*			M		

I = Introduced | P = Practiced | M = Mastered | M* = Mastered Assessed

5.7 Assessments of LO's.

The Assessment Plan follows five Program Goals. For each Program Goal, there are one or more Outcome Measures. Bulleting is used to show correspondence of subparts of Outcome Measures under different table headings.

Types of assessment:

Direct Assessments	Indirect Assessments
Assessments that require students to demonstrate their learning such that observers can determine how well they are meeting learning outcomes.	Assessments that imply the level or extent of learning or ascertain learner satisfaction or perception.
Examples may include Course assignments, essays, term or capstone projects, lab experiments, portfolios, presentations, defenses, publications, theses, dissertations, Exam questions, and creative works.	Examples may include surveys, questionnaires, interviews, and focus groups.

In the program of Bachelor in chemistry, we will use the following methods in assessing the program:

A. Direct Assessment: in direct assessment, our program will use the following two methods:

1. Measuring PLOs from higher course levels (i.e., in level 7 and 8)
2. Average course learning outcome results as crude data, it will be taken from the Course reports in the main campus and branches.

B. Indirect methods, using indirect tools principally surveys, student PLO surveys, graduate surveys,

Assessment Process

Assessment is an ongoing process in the Chemistry Department. NCAAA regulations and forms are implemented for all documentation. These generally include reviews of departmental offerings, course content, textbooks, and Examinations.

Faculty share and review Examinations, regularly collect student evaluations of teaching, assessment of learning outcomes for each course, and report the scores of CLOs each semester from various Exams. The Chemistry Department also plans to get feedback from alumni and employers periodically.

PLOs Assessment Plan using CLOs: The data are collected and evaluated every semester for PLOs assessment. An improvement plan report including a list of minor and major changes is then prepared according to the evaluation results of PLOs and their corresponding CLOs.

Minor changes can be implemented during the assessment cycle while the major changes can be implemented by the end of the assessment cycle timeline.

Target:

for courses (≥ 3 out of 5 to the attained score (≥ 60 %)

For the Program (3.5 out of 5 the attained score (70 %)

Assessment based on curriculum mapping

All requirements and characteristics of Mapping CLOs to PLOs: After the development of CLOs, they were mapped to PLOs to ensure that CLOs have certain contributions to the PLOs at different levels in the program.

According to our Mapping Matrix, we select the Hight level courses to measure the achievement of PLO as follows

Table 6: Assessment Table

PLO / COURSE	A-Direct Assessment										
	436 CHEM 3-	445 CHEM3-	446 CHEM 2-	CHEM 447	491 CHEM 2-	415 CHEM 4-	424 CHEM3	425 CHEM 2	438 CHEM 3	439 CHEM 3	448 CHEM2
K1			✓				✓				
K2	✓							✓			
S1				✓							✓
S2		✓				✓					
S3					✓					✓	
S4					✓				✓		
V1		✓				✓					
V2					✓						
B-Indirect Assessment											
PLO student survey Alumni survey Employment survey SES and PES											

An alternative Assessment plans

An alternative Assessment plan if the department can hold and approve the Exit-Exam for the program according to the university's plan

6 out of 8 outcomes will be measured within the test, which are;

PLOs		Method of assessment
K1	Demonstrate a broad understanding and critical view of the principal theories, concepts and terminology of chemistry area or field of work, and in addition the necessary background in Physics and Mathematics	Question tracking in EXIT- EXAM
K2	Describe correctly Chemical phenomena using chemical principles and scientific reasoning	Question tracking in EXIT- EXAM
S1	Demonstrate an ability in critical thinking, numeracy, statistical, analytical reasoning, use graphs, charts for solving problems (in the synthesis, measurement, and modeling of chemical systems),	Question tracking in EXIT- EXAM
S2	Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments in various fields of chemistry and to write a report representing the scientific data.	Question tracking in EXIT- EXAM
S3	Examine his material and lab safety background to Follow proper procedures and regulations for safe handling and use of chemicals.	Question tracking in EXIT- EXAM
V2	Perceive the ethical and social dimensions of practicing chemistry or any related field.	Question tracking in EXIT- EXAM

The other 2 PLOs will be assessed according to the following methods

PLOs		Method of assessment
S4	make effective use of communication, and online technology about chemistry topics in order to improve their basic knowledge in writing (report and paper/ poster) with a good verbal and clear scientific language.	*completed thesis report from 10 randomly selected students or (50% of the total student in each selected course) CHEM 491 CHEM 438*
V1	Work as a group leader in cooperation with other colleagues	*In-LAB work and related assignments that demonstrate equipment/ instrumentation skills / leadership / group work in courses; CHEM 415 CHEM 445*

The report will be completed every 3 years (6 semesters)

6. Program Study Plan

Students gain knowledge by completing numerous courses while enrolled in the Bachelor of Science in Chemistry program. The theory is given in lectures, and students practice the theory by doing activities during guided self-study. In the practical, students also develop practical skills. Students apply what they've learned in class and the lab to projects in which they work on a case alongside their classmates. Students use the same modern equipment as our experts throughout these practical projects. Because the lecturer will be present, students will have the opportunity to ask questions. Students can use their free time to pursue other interests, such as sports, student life, or side employment. The study program will take up about 40 hours of your time per week in total..1 Complete Study Plan (Courses List per Semester).

Our study plan was designed according to Saudi Arabia NQF, it contains 130 credits h, distributed in 8 Semesters (Levels). The following Table contains all courses and their levels;

Table 7: complete study plane

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Contact Hours		Total Credit Hours	workload	ECTS
					Lecture	Pract.			
First Year									
Level 1	101SLM 2	Islamic Culture I	R		2	0	2	103.6	3.7
	105ENGL-6	Intensive Course in English Language	R		12	3	6	310.8	11.1
	101BIO-4	General Biology	R		3	2	4	207.2	7.4
	101MATH-3	General Mathematics	R		3	0	3	154	5.5
	101CSC-3	Introduction to Computer.	R		2	2	3	154	5.5
	Total of Level 1				22	7	18	929.60	33.20
Level 2	102SLM-2	Islamic Culture II	R		2	0	2	103.6	3.7
	101ARB-2	Arabic Language Skills	R		2	0	2	103.6	3.7
	101PHYS-4	General Physics	R		3	2	4	207.2	7.4
	101CHEM-4	General Chemistry	R		3	2	4	190.00	6.79
	106ENGL-3	English for Science	R	105ENGL	3	0	3	154	5.5
	Total of Level 2				13	4	15	758.40	27.09
TOTAL of Year 1					**35**	**11**	**33**	1688.00	60.29
Second Year									
Level 3	102ARB-2	Arabic Writing	R		2	0	2	103.6	3.7
	103SLM-2	Islamic culture III	R		2	0	2	103.6	3.7
	201MATH-3	Calculus	R		3	0	3	154	5.5
	231CHEM-3	Aliphatic organic Chemistry	R		2	2	3	152.00	5.45
	211CHEM-3	Volumetric Analytical Chemistry	R		2	2	3	155.67	5.56
	201CHEM-3	General and physical Chemistry	R	101CHEM	3	2	4	206.17	7.36
	Total of Level 3				14	6	17	875.04	31.27
Level 4	104SLM-2	Islamic Culture IV	R		2	0	2	110.8	3.7
	202MATH -3	Differential Equations	R	201MATH	3	0	3	166.2	5.5
	212CHEM-3	Chemistry of Gravimetric Analysis	R		2	2	3	170.00	6.07
	221CHEM-4	Chemistry of Main Groups	R		3	2	4	221.67	7.92
	232CHEM-3	Aromatic Organic Chemistry	R	231CHEM	2	2	3	152.50	5.45
	241CHEM-3	Thermodynamics	R		2	2	3	151.67	5.42
	Total of Level 4				14	8	18	972.84	34.06
TOTAL of Year 2					**28**	**14**	**35**	1847.88	65.33
Third Year									
Level 5	313CHEM-3	Chromatographic Analysis	R		2	2	3	151.00	5.39
	322CHEM-4	Chemistry of Transition Elements	R	CHEM221	3	2	4	212.50	7.59
	333CHEM-3	Heterocyclic Organic Chemistry	R		2	2	3	175.33	6.26
	342CHEM-3	Kinetic Chemistry	R		2	2	3	174.00	6.21
	343CHEM-3	Surface Chemistry & Catalysis	R		3	0	3	159.17	5.68
	Total of Level 5				12	8	16	872.00	31.14
Level 6	314CHEM-3	Electrochemical analysis methods	R		2	2	3	174.17	6.22
	323CHEM-3	Co-ordination Chemistry	R	322CHEM	2	2	3	150.50	5.38
	334CHEM-2	Spectroscopy of Organic Compounds	R		2	0	2	110.83	3.96

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Contact Hours		Total Credit Hours	workload	ECTS
					Lecture	Pract.			
	335CHEM-3	Organic Reaction Mechanisms	R		2	2	3	153.33	5.48
	344CHEM-3	Electrochemistry	R		2	2	3	159.83	5.71
	Total of Level 6				10	8	14	748.67	26.74
TOTAL of Year 3					**22**	**16**	**30**	1620.67	57.88
Fourth Year									
Level 7	436CHEM-3	Chemistry of Natural Products	R		2	2	3	156.00	5.57
	437CHEM-2	Stereochemistry	R		2	0	2	108.33	3.87
	445CHEM-3	Solution Chemistry	R		2	2	3	165.00	5.89
	446CHEM-2	Polymer Chemistry	R		2	0	2	93.33	3.33
	447 CHEM-3	Quantum Chemistry	R	202MATH	3	0	3	164.17	5.86
	491CHEM-2	Graduation Project	R	Dep. Approval	1	2	2	144.17	5.15
	Total of Level 7				12	6	15	831.00	29.68
Level 8	415CHEM-4	Methods of Instrumental analysis	R	314CHEM	3	2	4	211.67	7.56
	424 CHEM-3	Lanthanides & Actinides	R	323CHEM	2	2	3	149.33	5.33
	425CHEM-2	Group Theory	R		2	0	2	107.50	3.84
	438CHEM-3	Organic applied chemistry	R		2	2	3	163.33	5.83
	439CHEM-3	Principles of Biochemistry	R		2	2	3	162.83	5.82
	448CHEM-2	Photochemistry	R		2	0	2	116.67	4.17
	Total of Level 8				13	8	17	911.33	32.55
TOTAL of Year 4					**25**	**14**	**32**	1742.33	62.23
Total					**110**	**55**	**130**	6898.88	245.72

6.2 Courses Descriptions.

1. General Chemistry 101CHEM-4

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
General Chemistry	*101 CHEM-4*	3	2	4	1st	2nd	-----

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	45	HW/Assignments	20
Laboratory	30	Case studies	
Exams and quizzes	6	Study for Exam	30
Lab demo	15	Working on lab experiment	15
		Preparation for classes	45
Total	80.00	Total	110.00
Total Learning Hours	190.00	Equivalent **ECTS points** = (Total LH/28)	6.79

(1) Brief Course Description

This course covers a variety of information about the different branches of chemistry that needed in the next stages

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Recognize the students some information about the different gas laws and their applications.
2. Recognize the students some properties of the liquids.
3. Recognize the students, the structure of the atoms, and the different atomic theories.
4. Recognize the students the chemical bonding and its properties.
5. Recognize the students the chemical elements and their properties from the periodic table.

(3) Course Contents

A- Theoretical:

The atomic structure- Periodic table- Chemical bonds- Gases- Chemical equilibrium – Ionic equilibrium- Liquids- Introduction to organic chemistry.

B- Practical

Identification of anions and cations of simple unknown organic salt.

Ass: selected experiments for the identification of anionic and cationic radicals.

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities:30%
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Principles of general chemistry, Remond Chang., Obeikan Library, August 2014

(7) Reference Books

- Principles and Applications of general chemistry, Remond Chang. chemistry.com.pk/books/chemistry (10th Edition), 2017.
- Introduction to organic chemistry, (7th Edition) written by Mark Weller, Tina Overton, Jonathan Rourke and Fraser Armstrong, Published by chemistry.com.pk. November 17, 2020
- Introduction to physical chemistry, David Ronis, published by McGill University, 2015.

2. General and Physical chemistry 201CHEM-4

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
General and Physical chemistry	*201CHEM -4*	*3*	*2*	*4*	2nd	3rd	*101CHEM-4*

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	45	HW/Assignments	16
Laboratory	30	Case studies	0
Exams and quizzes	15	Study for Exam	25
Lab demo	18	Working on lab experiment	30
		Preparation for classes	45
Total	**90.00**	Total	**116.00**
Total Learning Hours	206.00	Equivalent **ECTS points** = (Total LH/28)	7.36

(1) Brief Course Description

This course covers some information about the different chemical items; Thermochemistry, Solutions, Chemical kinetics, Thermodynamics, Redox reactions and Electrochemistry, Atomic and molecular structure, Chemistry, and Ecology.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Identification of the laws of thermal chemistry and its various applications.
2. Identify the types of solutions
3. Identification of the laws of thermodynamics, and their various functions.
4. Identify the different forms of energy and the possibility of turning any of them to other forms.
5. Identification of chemical contaminants and methods of monitoring, and disposal

(3) Course Contents

A- Theoretical:

Study Thermochemistry and thermodynamics, Solutions, Chemical kinetics, Redox reactions and Electrochemistry, Acids and bases, Atomic and Molecular Structure, Chemistry and Ecology.

B- Practical

Selected experiments in the Identification of the basic radicals of inorganic salt mixtures.

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities: 30%
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

الكيمياء العامة: المفاهيم الأساسية ، ريموند تشانغ ،العبيكان للنشر

Raymond, Chang, General Chemistry: The Essential Concepts 5th Edition 2018, ISBN-13: 978-0073311852

(7) Reference Books

- Physical Chemistry, Peter Atkins, Julio de Paula, Julio DePaula W. H. Freeman, 2005.
- Physical Chemistry, 4th Edition Robert J. Silbey. Robert A. Alberty. Moungi G. Bawendi v. TM. Cambridge, Massachusetts. January 2004

3. Volumetric analytical Chemistry 211 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Volumetric analytical Chemistry	*211CHEM-3*	*2*	*2*	*3*	2nd	3rd	-----

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	30	HW/Assignments	14
Laboratory	30	Case studies	0
Exams and quizzes	10	Study for Exam	25
Lab demo	10	Working on lab experiment	25
		Preparation for classes	25
Total	**66.67**	Total	**89.00**
Total Learning Hours	155.67	Equivalent **ECTS points** = (Total LH/28)	5.56

(1) Brief Course Description

This course covers the theoretical and practical principles of the different methods of volumetric analysis

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Basic principles of volumetric analysis
2. Different unites to express concentrations
3. Different types of titrations and their applications
4. Preparation of solutions with different concentrations

(3) Course Contents

A- Theoretical:

Basic principles and concepts of volumetric analysis. Different units of concentrations. Different types of titrations as neutralization, oxidation reduction, complexmetric, and precipitation titrations.

B- Practical

Selected experiments related to volumetric analysis

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities: 30 %
- Final Exam: 50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Quantitative Chemical Analysis, Daniel C. Harris, Charles A. Lucy Kate Parker publisher, 9th edition 2015.

(7) Reference Books

Fundamentals of Analytical Chemistry" - by Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch, Mary Finch publisher 9th edition 2013.

4. Chemistry of Gravimetric Analysis 212 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Chemistry of Gravimetric Analysis	*212CHEM-3*	2	2	3	3rd	4th	----

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	30	HW/Assignments	15
Laboratory	30	Case studies	0
Exams and quizzes	15	Study for Exam	25
Lab demo	15	Working on lab experiment	30
		Preparation for classes	25
Total	**75.00**	Total	**95.00**
Total Learning Hours	170.00	Equivalent **ECTS points** = (Total LH/28)	6.07

(1) Brief Course Description

This course covers the basic principles and experimental applications of some gravimetric methods, especially precipitation gravimetry

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Basic principles, definitions, and classifications of gravimetric methods
2. Theories, mechanisms, steps, and applications of precipitation gravimetry
3. Gravimetric, solubility, and solubility product calculations
4. Types of impurities in precipitates and their minimization.
5. Determination of different cations and anions using precipitation gravimetry.

(3) Course Contents

A- Theoretical:

Basic principles, definitions, and classifications of gravimetric methods. Theories, mechanisms, steps, advantages, disadvantages, and applications of precipitation gravimetry. Different calculations such as gravimetric calculations, solubility, solubility products, amount of precipitating agent, and pH at which precipitation starts and completes. Impurities in precipitates and their minimization. Precipitation from homogeneous solutions.

B- Practical

Selected experiments related to gravimetric analysis

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities: 30 %
- Final Exam: 50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Analytical chemistry, Christian, Gary D., Purnendu K. (Sandy), Kevin A. Schug, 7th edition (2014)

(7) Reference Books

- Quantitative Chemical Analysis & Solutions manual by Daniel C. Harris, 2006.

5- Chemistry of Main Groups 221 CHEM-4

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Chemistry of Main Groups	*221CHEM-4*	3	2	4	2nd	4th	----

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	45	HW/Assignments	30
Laboratory	30	Case studies	0
Exams and quizzes	8	Study for Exam	40
Lab demo	15	Working on lab experiment	30
		Preparation for classes	40
Total	**81.67**	Total	**140.00**
Total Learning Hours	221.67	Equivalent **ECTS points** = (Total LH/28)	7.92

(1) Brief Course Description

This course covers the basic information about the General properties of S and b-block elements in the periodic table.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Recognizing the elements and their chemical and physical properties.
2. Recognizing the periodic table of the elements.
3. Recognizing the properties of elements by knowing the group that belong to.

(3) Course Contents

A- Theoretical:

Study effective nuclear charge - formal charge - draw a molecular orbital diagram for the molecule - Study of the properties of the elements in the groups and periods of the periodic table – Chemistry of hydrogen – Elements of the first group (Alkali Metals) – Elements of the second group (Alkaline Earth Metals) - Elements of the third group – Elements of the fourth group – Elements of the fifth group – Elements of the sixth group – Elements of the seventh group (Halogens) – Elements of the eighth group (Noble Gases).

B- Practical

Selected experiments in qualitative and quantitative analysis.

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities: 30 %
- Final Exam:50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Inorganic Chemistry, 5th Edition by Gary L. Miessler, Paul J. Fischer, Donald A. Tarr, (2013)

(7) Reference Books

- Concise Inorganic Chemistry, 5th Edition, J.D. Lee, Blackwell Science Ltd (1996)

6- *Aliphatic Organic Chemistry 231 CHEM-3*

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Aliphatic Organic Chemistry	*231CHEM-3*	2	2	3	2nd	3rd	----

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	9	Study for Exam	20
Lab demo	12	Working on lab experiment	20
		Preparation for classes	25
Total	**81**	Total	**85**
Total Learning Hours	166	Equivalent **ECTS points** = (Total LH/28)	5.93

(1) Brief Course Description

This course covers the basic knowledge concerning saturated and unsaturated aliphatic organic compounds, their nomenclature, methods of preparation, and their most important chemical reaction

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Identifying and analyzing the structure of organic compounds by recognizing main functional groups.
2. Naming the compounds using the I.U.P.A.C. system.
3. Predicting the major product in organic reactions and their properties.
4. Describing different types of reactions as nucleophilic substitution, elimination, and electrophilic addition

(3) Course Contents

A- Theoretical:

Principles of organic chemistry and its importance – molecular structure and properties of organic compounds – functional groups in organic compounds –principle organic reactions – studying different classes of aliphatic organic compounds including; nomenclature, chemical structure, physical properties, methods of preparation, chemical reactions and common uses of: saturated and unsaturated aliphatic compounds

B- Practical

Basic knowledge concerning general Safety Rules, Lab Equipment, Basic Laboratory Techniques, Measuring Volume and melting point, Purification of Organic Compounds, and sublimation. Finally, the Identification of unknown liquid and solid organic compounds.

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20 %
- Assignments and classroom activities:30 %
- Final Exam: 50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Organic Chemistry, 12th Edition, T. W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder ISBN: 978-1-119-24370-0 November 2016Edition 2015.

(7) Reference Books

- Organic Chemistry, 12th Edition, T. W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder ISBN: 978-1-119-24370-0 November 2016Edition 2015.

7- *Aromatic organic chemistry 232 CHEM-3*

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Aromatic organic chemistry	232CHEM-3	2	2	3	2nd	3rd	231CHEM-3

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	9	Study for Exam	20
Lab demo	12	Working on lab experiment	20
		Preparation for classes	25
Total	**67.50**	Total	**85.00**
Total Learning Hours	152.50	Equivalent **ECTS points** = (Total LH/28)	5.45

(1) Brief Course Description

This course covers the basic knowledge concerning aromatic organic compounds, their methods of preparation, properties and their most important chemical reactions

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1- Identifying the properties of aromatic organic compounds
2- To provide students with the basic knowledge concerning the nomenclature of aromatic organic compounds.
3- To familiarize students with the methods of preparation of aromatic compounds and their different chemical reactions
4- To familiarize students with the importance of aromatic compounds and their applications

(3) Course Contents

A- Theoretical:

Nomenclature, Physical properties, reactivity, classification, preparation, reactions, and their application for aliphatic and aromatic; Halo Compounds, Alcohols and Ethers, Phenols, Aldehydes and Ketones, Carboxylic Acids, Carboxylic Acid derivatives, Aromatic Nitro-Compounds, Amines, Aromatic Diazonium Salts and Their Related Compounds, Aromatic Sulphonic Acids.

B- Practical

Selected experiments related to the course content; Investigation of organic solid compounds and Identification methods of liquid organic compounds

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20 %
- Assignments and classroom activities: 30 %
- Final Exam: 50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Organic Chemistry, 12th Edition, T. W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder ISBN: 978-1-119-24370-0 November 2016Edition 2015.

(7) Reference Books

- Organic Chemistry, 12th Edition, T. W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder ISBN: 978-1-119-24370-0 November 2016Edition 2015.

8- Thermodynamics 241 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Thermodynamics	**241CHEM-3**	**2**	**2**	**3**	**2nd**	**4th**	**----**

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	11	Study for Exam	20
Lab demo	15	Working on lab experiment	20
		Preparation for classes	20
Total	**71.67**	Total	**80.00**
Total Learning Hours	151.67	Equivalent **ECTS points** = (Total LH/28)	5.42

(1) Brief Course Description

This course covers the basic information about the thermodynamic chemistry, laws, thermochemistry, and phase Rule.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1) Identify the types of thermodynamic systems and processes
2) Recognize the different thermodynamic laws and thermochemistry
3) Calculate the required thermodynamic parameters by solving problems
4) Identify the applications of thermodynamic phenomena
5) Understand the phase rule and related phase transitions
6) Investigate one, two, and three-component systems and calculate the degree of freedom

(3) Course Contents

A- Theoretical:

Heat and work, Heat capacity, specific heat, thermodynamic process, thermodynamic laws: thermochemistry, Carnot cycle, Joule-Tomson effect Gibbs- Helmholtz free energy, phase rule, system with different components.

B- Practical

Experimental work illustrating selected parts of the theoretical content.

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20%
- Assignments and classroom activities:30 %
- Final Exam:50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Physical Chemistry (2nd Edition) by David W. Ball, Cleveland State University, 2014

(7) Reference Books

- Translated Arabic version of Peter Atkins (KSU)

9- *Chromatographic Analysis 313 CHEM-3*

Course Title	Course Code	Number of Study Hours			Year	Level	Pre-requisites
		Theo.	Lab.	Credit			
Chromatographic Analysis	**313CHEM-3**	**2**	**2**	**3**	**3rd**	**5th**	**----**

In-class activities		Self-learning/study	
items	**Contact Hours**	**items**	**Hours**
Lectures	30	HW/Assignments	18
Laboratory	30	Case studies	0
Exams and quizzes	15	Study for Exam	18
Lab demo	15	Working on lab experiment	15
		Preparation for classes	25
Total	**75.00**	Total	**76.00**
Total Learning Hours	151.00	Equivalent **ECTS points** = (Total LH/28)	5.39

(1) Brief Course Description

This course covers an introduction to the principles and theories of chromatographic analysis as a tool of separation for quantitative analysis and qualitative analysis. The course will also cover the applications of chromatographic analysis.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Develop a basic understanding of chromatography principles and theories.
2. Recognize the advantages and limitations of the main chromatographic techniques.
3. Calculate chromatographic factors and constants.
4. Interpret chromatographic data and results.
5. Develop basic experimental skills in chromatographic analysis

(3) Course Contents

A- Theoretical:

definitions of chromatographic analysis terms and parameters, classifications of chromatographic methods, advantages, and disadvantages of the different techniques. It will also cover the main theories of chromatography and calculating and interpreting chromatographic factors and parameters. Applications of chromatographic analysis will also be discussed.

B- Practical

Practical applications of different chromatographic separation techniques

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20%
- Assignments and classroom activities:30 %
- Final Exam:50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1- Skoog, Douglas, Donald West, F. L. Holler, and Stanley Crouch. Fundamentals of analytical chemistry. Cengage Learning,9th Edition 2014.

2- سلامة، أحمد خميس محمد. التحليل الكروماتوجرافي (اساسيات وطرق التحليل). جامعة المجمعة، الطبعة الأولى، 2015 .

3- العسود، بسام إبراهيم. التحليل الآلي. دار الفكر، الطبعة الأولى، 2011.

(7) Reference Books

1. Skoog, Douglas, Donald West, F. L. Holler, and Stanley Crouch. Fundamentals of analytical chemistry. Cengage Learning,9th Edition 2014.
2. Ahuja, Satinder. Chromatography and separation science. Vol. 4. Academic Press, 2003.
3. Miller, James M. Chromatography: concepts and contrasts. John Wiley & Sons, 2nd Edition, 2005.
4. Braithwaite, Alan, and J. F. Smith. Chromatographic methods. Springer, 5th Edition, Reprint 1999.

10- Electrochemical analysis methods 314 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Electrochemical analysis methods	**314CHEM-3**	**2**	**2**	**3**	**3rd**	**6th**	**----**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	20	Study for Exam	30
Lab demo	15	Working on lab experiment	15
		Preparation for classes	30
Total	**79.17**	Total	**95.00**
Total Learning Hours	174.17	Equivalent **ECTS points** = (Total LH/28)	6.22

(1) Brief Course Description

This course covers the basic principles and experimental applications of some electro-analytical methods and their usage in chemical analysis

(2) Course Objectives

This course has been designed to provide students with the following concepts:

2- Basic principles of analytical electrochemistry and electro-analytical methods
3- Using some electro-analytical techniques in chemical analysis
4- Experimental applications of some electro-analytical methods.

(3) Course Contents

A- Theoretical:

Basic principles, concepts, instrumentation, and applications of some electro-analytical methods such as potentiometry including ion selective electrodes, electrogravimetry, coulometry, conductometry, voltammetry including polarography and amperometric titrations.

B- Practical

Selected experiments related to electro-analytical methods

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities:30 %
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

-Undergraduate Instrumental Analysis, James W. Robinson, Eileen M. Skelly Frame and George M. Frame II, Taylor & Francis Group publisher, 7th edition (2014).

(7) Reference Books

-Analytical Electrochemistry, by Joseph Wang, John Wiley & Sons. Publisher, 2nd edition (2006)

11- Chemistry of Transition Elements 322 CHEM-4

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Chemistry of Transition Elements	**322CHEM -4**	**3**	**2**	**4**	**3rd**	**5th**	**221CHEM-4**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	45	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	15	Study for Exam	30
Lab demo	15	Working on lab experiment	30
		Preparation for classes	45
Total	**87.50**	Total	**125.00**
Total Learning Hours	212.50	Equivalent **ECTS points** = (Total LH/28)	7.59

(1) Brief Course Description

This course covers the transition elements (d-block elements) and recognizes their chemical and physical properties and their various uses.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1- Recognizing the transition elements.
2- Recognizing the properties of these elements.
3- Recognizing the bond theories of the complexes.
4- Using the molecular orbital theory.

(3) Course Contents

A- Theoretical:

Chemistry of transition elements – General properties of transition elements – Alloys – Molecular spectrum – Magnetic properties – Chemical equilibrium – Introduction to theories which describe the electronic bonding of the complexes

B- Practical

Selected experiments related to preparing and studying of double salts and complexes

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities:30 %
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1- Concise Inorganic Chemistry, J. D. Lee, 5TH ED, Wiley India Pvt. Limited, 2008.

2- العناصر الانتقالية الأساسية وكيمياء التناسق، د. حسين محمد عبدالفتاح، د. سمير أبو القاسم عبداللطيف، الطبعة الثانية، دار -النشر الدولى 2012

(7) Reference Books

1- Inorganic Chemistry: Principles of Structure and Reactivity, Okhil K. Medhi, James E. Huheey, Richard L. Keiter, Ellen A. Keiter, 4th Ed., Pearson Education Singapore Pte Ltd., 2006.

2- Advanced Inorganic Chemistry, Author: Cotton Wilkinson Murillo Bochmann, 6th Edition, Wiley India Pvt Ltd., 2012.

12- Coordination chemistry 323 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Coordination chemistry	**323CHEM-3**	**2**	**2**	**3**	**3rd**	**6th**	**322CHEM-4**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	12	Study for Exam	18
Lab demo	15	Working on lab experiment	15
		Preparation for classes	25
Total	**72.50**	Total	**78.00**
Total Learning Hours	150.50	Equivalent **ECTS points** = (Total LH/28)	5.38

(1) Brief Course Description

This course covers the coordination and organometallic compounds, their methods of preparation and their uses

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Recognizing the stereochemistry of complexes and molecular symmetry.
2. Recognizing the concept of donating and accepting atom.
3. Recognizing the nomenclature rules of the complexes.
4. Recognizing the types of ligands and the coordination number.
5. Recognizing the polar and non-polar molecules.
6. Recognizing the methods of preparation of organometallic compounds.
7. Recognizing the uses of organometallic compounds.

(3) Course Contents

A- Theoretical:

- Coordination Chemistry: Concept of donating and accepting atoms – Types of ligands – Coordination number - Stereochemistry of complexes and molecular symmetry – Central atom groups - Nomenclature rules of the complexes – Crystal field theory – Molecular orbital theory.
- Organometallic Chemistry: General rules – Different methods of preparation – Uses of organometallic compounds in the organic preparations (organic compounds of lithium, magnesium, boron, aluminum and silicon) – Organometallic compounds of transition elements, reactions of these compounds and their uses in organic preparations.

B- Practical

Selected experiments Selected experiments related to preparation and reactions of the complexes

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20%
- Assignments and classroom activities:30%
- Final Exam:50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1. Concise Inorganic Chemistry, J. D. Lee, 5TH ED, Wiley India Pvt. Limited, 2008.
2. Introduction to Coordination Chemistry, G. A. Lawrance, A John Wiley and Sons, Ltd., 2010
3. Direct Synthesis of Coordination and Organometallic Compounds, A.D. Garnovskii and B.I. Kharisov, Elsevier Science, 1999.

(7) Reference Books

1. Inorganic Chemistry: Principles of Structure and Reactivity, Okhil K. Medhi, James E. Huheey, Richard L. Keiter, Ellen A. Keiter, 4th Ed., Pearson Education Singapore Pte Ltd., 2006.
2. Advanced Inorganic Chemistry, Author: Cotton Wilkinson Murillo Bochmann, 6th Edition, Wiley India Pvt Ltd., 2012.

13- Heterocyclic Organic Chemistry 333 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Heterocyclic Organic Chemistry	333CHEM-3	2	2	3	3rd	5th	----

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	20	Study for Exam	22
Lab demo	20	Working on lab experiment	20
		Preparation for classes	30
Total	83.33	Total	92.00
Total Learning Hours	175.33	Equivalent **ECTS points** = (Total LH/28)	6.26

(1) Brief Course Description

This course covers the basic knowledge of heterocyclic organic compounds, their physical and chemical properties, and their most important chemical reactions.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1- Identification and classification of heterocyclic organic compounds.
2- To identify the physical properties of heterocyclic organic compounds.
3- Study of the addition reactions, the electrophilic and nucleophilic substitution reactions on a five and six-membered ring with one and two heteroatoms.

(3) Course Contents

A- Theoretical:

Definition, classification, and nomenclature of heterocyclic organic compounds - physical properties of heterocyclic compounds – Addition reactions, electrophilic and nucleophilic substitution reactions of five and six-membered rings with one or two heteroatoms- pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, thiazole, isothiazole, azine, thiazine, pyridine, alkyl pyridine, pyridazine, pyrimidine and quinoline – Synthesis of five and six-membered rings with one or two heteroatoms - some poly-heterocyclic compounds - synthesis and reactions

B- Practical

Selected experiments related to hetero-chemistry topics.

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities:30%
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1- - Heterocyclic Chemistry, John A. Joule, Keith Mills.; 5th Edition, June 2010, Wiley-Black well, ISBN: 978-1-405-13300-5, pages718
2- Practical Heterocyclic Chemistry, A. O. Fitton R. K. Smalley, 1st Edition, Academic Press, 1968.

(7) Reference Books

1- Heterocyclic chemistry; Gilchrist, T. L. 3rd ed.; Addison Wesley Longman: Edinburgh Gate, 1997.
2- Heterocyclic chemistry; Joule, J. A.; Mills, K.; 4th ed.; Blackwell Science: Oxford, 2000.
3- 3. Heterocyclic Chemistry, R. R. Gupta, M. Kumar, V. Gupta, Volume II: Five-Membered Heterocycles, Springer, ISBN 978-3-642-08460-7, 1999.

14- Spectroscopy of Organic Compounds 334 CHEM-2

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Spectroscopy of Organic Compounds	334CHEM-2	2	0	2	3rd	6th	----

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	20
Laboratory	0	Case studies	10
Exams and quizzes	7	Study for Exam	20
Lab demo	0	Working on lab experiment	0
		Preparation for classes	30
Total	30.83	Total	80.00
Total Learning Hours	122.83	Equivalent **ECTS points** = (Total LH/28)	3.96

(1) Brief Course Description

This course covers the basic knowledge of different regions of electromagnetic radiation and their properties to develop skills in the elucidation of the molecular structure of organic compounds

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1- To understand different regions of electromagnetic radiation and their interaction with atoms and molecules.
2- To identify the spectra due to the electronic absorption.
3- The basic principles of nuclear magnetic resonance spectroscopy.

(3) Course Contents

A- Theoretical:

Empirical, Molecular, Structural formula and Index of hydrogen deficiency. The Electromagnetic radiation - interaction with atoms and molecules – the electronic absorption
– Ultraviolet and visible spectroscopy (UV) – effect of molecular structure and stereochemistry of compounds on electronic absorption – Infrared spectroscopy (IR) – effect of molecular structure on stretching and bending vibrations (conjugation – induction – hydrogen bonding –stereo positions) – Nuclear magnetic resonance spectroscopy – the magnetic nuclei – effect of external magnetic field on magnetic nuclei – shielding and deshielding effect - spinning protons – splitting of signals– chemically and magnetically equivalent protons – integration – coupling constant – exchangeable protons with deuterium – mass spectrometry – formation of molecular ion – rules of fragmentation of molecular ions – isotopes in nature – molecular ion area – high resolution mass spectrometry.

B- Practical

None

(4) Assessment Criteria

- Mid Term Exam and Quizzes:30 %
- Assignments and classroom activities:10 %
- Final Exam:60%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1.-Introduction to spectroscopy, D.L.Pavia, G.M.Lampnon , .S.Kriz,3rd ed.2000, Brooks, Cole Pub.Co

(7) Reference Books

1. Spectroscopy of Organic Compounds 6th ed., Kalsi, New Age International (p) Ltd, 2004
2. Introduction to Spectroscopy, 5th Edition AUTHORS: Pavia/Lampman/Kriz/Vyvyan - ©2015

15- Organic Applied Chemistry 438 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Organic Applied Chemistry	438CHEM-3	2	2	3	4th	8th	----

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	
Exams and quizzes	16	Study for Exam	25
Lab demo	0	Working on lab experiment	25
		Preparation for classes	30
Total	63.33	Total	100.00
Total Learning Hours	163.33	Equivalent **ECTS points** = (Total LH/28)	5.83

(1) Brief Course Description

This course covers basic information about petroleum, Petrochemicals, Polymers, and Dyes with their classifications, applications, and their uses.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Discuss the occurrence, extraction, and properties of petroleum and the application of fractional distillation, catalytic cracking, and catalytic reforming during petroleum processing.
2. Describe using equations and flow diagrams, the manufacture of some petrochemicals, namely, ethylene, propylene, synthetic gas, benzene, and inorganic petrochemicals.
3. identify polymers, their physical properties, and different kinds of addition polymerization
4. Identify the characteristics of some common polymers and the industrial importance of polymers and their uses in various fields.
5. Identify the types of pigments and paints.
6. Discuss the classification, synthesis, and uses of dyes.

(3) Course Contents

A- Theoretical:

The course is designed to give the students an idea about polymer science – definition, classification of polymers, and polymerization by addition (chain reaction) – ionic polymerization (anionic and cationic) – free radical polymerization –polymerization by condensation– (linear polymerization– cross-section polymerization). Introduce an idea about petroleum, Petrochemicals, and industrial applications of organic chemistry, such as organic polymers and their uses in various fields and the manufacture of dyes and paints.

B- Practical

Basic knowledge concerning general Safety Rules, Lab Equipment, Purification of Organic Compounds, synthesis of some polymers, soap, cream, and some dyes and examination of their properties and their applications.

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 20%
- Assignments and classroom activities30 %
- Final Exam: 50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

-Industrial Organic Chemicals by Harold A. Wittcoff, Bryan G. Reuben and Jeffery S. Plotkin, 2012 | ISBN: 0470537434

(7) Reference Books

1.كتاب الصناعات البترولية والبتروكيماوية ... تأليف أ. د سالم بن سليم الذياب
2.كيمياء و تقنية البوليمرات بواسطة أ. د. سالم سليم الذياب

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16- Lanthanides & Actinides 424 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Lanthanides & Actinides	424CHEM-3	2	2	3	4th	8th	*323CHEM-3*

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	20
Laboratory	30	Case studies	
Exams and quizzes	16	Study for Exam	20
Lab demo	12	Working on lab experiment	20
		Preparation for classes	16
Total	73.33	Total	76.00
Total Learning Hours	149.33	Equivalent **ECTS points** = (Total LH/28)	5.33

(1) Brief Course Description

This course covers some information about nuclear fission and fusion, how to measure the doses of radiation, recognizing the effect of radiation and the methods of protection, and giving an idea about the elements of lanthanides and actinides

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Recognizing the concept of nuclear fission and fusion.
2. Recognizing the method of measuring and high radiation doses
3. Recognizing the effect of radiation on biological systems and the ways of protection.
4. Recognizing the lanthanides and actinides elements.
5. Recognizing the electronic structures, chemical and physical properties, and the reactions of those elements

(3) Course Contents

A- Theoretical:

- Nuclear and Radiochemistry: The nature of nuclear and radiochemistry and the sources of ionizing radiation – Radiation decay and standard units – Radiation interaction with matter – Theories related to the structure of nucleus – Nuclear fission and fusion and emitted energy – Measurement of low and high radiation doses – The effect of radiation on biological systems and the ways of protection.
- Lanthanides Group: Comparative study between lanthanides and transition elements – Comparative study between lanthanides and alkaline earth metals – The electronic structure of the elements – Different oxidation states – The physical properties such as magnetic, spectral and color properties – Electronic shield – Methods of separation: Fractional crystallization, ion exchange, etc.
- Actinides Group: electronic structure – Methods of preparation – Radiation decay – Element enrichment

B- Practical

Selected experiments related to the determination of lanthanides, their chemical reactions and methods of separation

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20 %
- Assignments and classroom activities:30 %
- Final Exam:50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1. Lee, J. D. (2009) Concise Inorganic Chemistry, 5 th Edition Authorized Reprint Published by Blackwell Science Limited, France.
2. F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus. Basic Inorganic Chemistry, 3rd Edition ISBN: 978-0-471-50532-7 January 1995,

(7) Reference Books

1. Simon A. Cotton, (2013) Lanthanide and Actinide Chemistry, Macmillan Education, 204p.
2. Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg (2017) Modern Nuclear Chemistry, John Wiley & Sons.

17- polymer Chemistry 446 CHEM-2

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
polymer Chemistry	446CHEM-2	2	0	2	4th	8th	---

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	20
Laboratory		Case studies	10
Exams and quizzes	16	Study for Exam	15
Lab demo		Working on lab experiment	
		Preparation for classes	20
Total	38.33	Total	55.00
Total Learning Hours	93.33	Equivalent **ECTS points** = (Total LH/28)	3.33

(1) Brief Course Description

This course covers This course aims to give students the fundamental principles of polymer chemistry, mechanism, kinetics, morphological structure, and its chemical industrial applications

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. 1Nomenclature, classification and synthesis of polymers
2. Mechanisms and kinetics of polymer reactions
3. structural morphology and composition of polymeric materials (Crystallinity and Amorphous polymers)
4. Physical properties (Thermal, mechanical and molecular weight distribution) of polymeric materials
5. The applications of polymeric materials (packaging-Medical

(3) Course Contents

A- Theoretical:

-Polymer solution behaviors - Physical and structural morphology of polymers - Mechanical and thermal properties of polymers

B- Practical

none

(4) Assessment Criteria

- Mid Term Exam and Quizzes:30%
- Assignments and classroom activities: 10%
- Final Exam: 60%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Introduction to Physical Polymer Science, Fourth Edition Author(s): L.H. Sperling 2006 John Wiley & Sons, Inc.

(7) Reference Books

- Polymer Physics (Chemistry) by M. Rubinstein and Ralph H. Colby, 2003. Photochemistry, Past, Present and Future; Angelo Albini, Springer-Verlag Berlin Heidelberg 2016, ISBN 978-3-662-47976-6

18- Organic Reactions Mechanisms 335 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Organic Reactions Mechanisms	**335CHEM-3**	**2**	**2**	**3**	**3rd**	**6th**	**----**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	30	HW/Assignments	10
Laboratory	30	Case studies	0
Exams and quizzes	6	Study for Exam	20
Lab demo	10	Working on lab experiment	30
		Preparation for classes	30
Total	**63.33**	Total	**90.00**
Total Learning Hours	153.33	Equivalent **ECTS points** = (Total LH/28)	5.48

(1) Brief Course Description

This course covers types of reactions and their basic principles of organic reaction mechanisms (atomic orbitals bonds in organic compounds - properties of organic reactions), etc…

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Types of organic reactions.
2. Identify the factors affecting the mechanism of organic reactions.
3. Identification of substitution, elimination, and addition reactions.
4. Studying the reaction mechanisms of the reactions.
5. Recognition of the role of Stereochemistry during the mechanism of reactions.

(3) Course Contents

A- Theoretical:

A general introduction to the mechanics of organic reactions – including (atomic orbitals - the bonds in organic compounds - properties of organic reactions) Classification of organic reactions - Electrophilic substitution in aromatic systems, Nucleophilic substitution reaction (SN1, SN2) on saturated carbon atom; mechanistic pathways, nature of the transition state and relative reactivity, Elimination reaction (E1, E2); mechanistic pathways, nature of the transition state and relative reactivity, rearrangement reactions, Addition reactions on carbonyl group, Addition reactions at (C=C) double bond, Name reactions.

B- Practical

Selected experiments related to the course topics

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20%
- Assignments and classroom activities:30%
- Final Exam:50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1. Peter Sykes/ A guidebook to the mechanism in organic chemistry.
2. Jerry March / Advanced organic chemistry- Reactions, Mechanisms, Structures.

3. Organic Reactions, Larry E. Overman, John Wiley & Sons, 2002.
4. Organic Reaction Mechanisms, Gallego, Techmedia, 2004
5. Advanced Organic Chemistry: Part A: Structure And
6. Mechanisms, Carey, Springer Verlag Gmgh , 2007.

(7) Reference Books

1. A Guidebook to Mechanism in Organic Chemistry, Peter Sykes Third Edition, Longman U.K., (1996).
2. Understanding Organic Reaction Mechanisms, Adam Jacobs, Cambridge University Press, 1997.

19- Stereochemistry 437 CHEM-2

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Stereochemistry	437CHEM-2	2	0	2	4th	7th	---

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	15
Laboratory		Case studies	10
Exams and quizzes	10	Study for Exam	20
Lab demo		Working on lab experiment	
		Preparation for classes	30
Total	33.33	Total	75.00
Total Learning Hours	108.33	Equivalent **ECTS points** = (Total LH/28)	3.87

(1) Brief Course Description

This course covers the basic principles of stereo models, projections, symmetry, and dynamic and static stereochemistry

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. To identify the dynamic and static stereochemistry concepts.
2. To identify different shapes of organic compounds and nomenclature of chiral compounds.
3. To distinguish between chiral and achiral compounds.
4. To identify the spatial models, sequence rules, and priority
5. To identify some organic reactions (addition, elimination, and rearrangement) and their stereochemistry

(3) Course Contents

A- Theoretical:

General introduction of stereochemistry – isomerism- conformation - spatial models - sequence rules - Cis- and Trans- stereoisomerism - chirality and prochirality - optical activity – Enantiomers and diastereomers - meso compound - Dynamic Stereochemistry including, addition, elimination, and rearrangement reactions.

B- Practical

None

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 30 %
- Assignments and classroom activities: 10 %
- Final Exam: 60 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Organic Chemistry, David R. Klein (Johns Hopkins University), John Wiley & Sons, Inc., 2010.

(7) Reference Books

1. Stereochemistry, R K Sharma, Discovery Publishing House, 2007.
3. Organic Stereochemistry, Robinson, Oxford University Press N Delhi, 2005.
4. Organic Chemistry, T.W. Graham Solomons and Craig B. Fryhle.A Guide Book to Mechanism in Organic Chemistry, Peter Sykes.

20- Graduation Project 491 CHEM-2

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Graduation project	491CHEM2	1	2	2	4th	7th	Department Approval

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	15	HW/Assignments	
Laboratory	30	Case studies	20
Exams and quizzes	5	Study for Exam	20
Lab demo	15	Working on lab experiment	30
		Preparation for classes	20
Total	54.17	Total	90.00
Total Learning Hours	144.17	Equivalent **ECTS points** = (Total LH/28)	5.15

(1) Brief Course Description

This course aims to aims to expand the student's knowledge of chemistry research in a research specialization chosen by the student. This will include understanding the process through which research is planned, carried out, and reported. There is also significant interaction with the research group of the supervisor chosen for the project**.**

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Conduct, Express, and Discuss Laboratory and/or Field Work.
2. Discuss Results and Write Scientific Paper

(3) Course Contents

A- Theoretical:

The course Graduation Project aims to give the students the opportunities to Choose, conduct a Literature Survey Conduct a Survey of Materials and Methods, Conduct Laboratory and/or Field Work, Collect Experimental and/or Field Data, Express Experimental and/or Field Data, Write Scientific Paper, Write Results, Discuss Results and Present Thesis for Graduation Research Project and Viva.

B- Practical

To be determined by the supervisor

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 0 %
- Assignments and classroom activities: 50 %
- Final Exam: 50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- To be determined by a supervisor from available sources.

(7) Reference Books

- To be determined by a supervisor from available sources.

21- Chemistry of Natural Products 436 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Chemistry of Natural Products	436CHEM-3	2	2	3	4th	7th	-----

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	16
Laboratory	30	Case studies	0
Exams and quizzes	12	Study for Exam	15
Lab demo	30	Working on lab experiment	20
		Preparation for classes	20
Total	**85.00**	Total	**71.00**
Total Learning Hours	156.00	Equivalent **ECTS points** = (Total LH/28)	5.57

(1) Brief Course Description

This course covers the basic knowledge about the main classes of natural products, means of extraction, isolation, structure characterization, and their most important uses

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1- The main classes of natural products and their types.
2- Terpenoid; its classification and methods of isolation.
3- Amino and fatty acids, alkaloids, their importance, types, and means of extraction.
4- Natural phenolic compounds and their extraction, isolation, and structure elucidation

(3) Course Contents

A- Theoretical:

Definition and classification of different classes of natural products and their isolation by different chromatographic methods- Structure elucidation using physical and chemical methods. Some chemical reactions and biosynthesis of terpenes, steroids, alkaloids, and natural phenolic (flavonoids, xanthones, anthraquinone, and coumarins.

B- Practical

Preparation and identification of some organic compounds, (such as aspirin - Benzoyl Glycine – benzamide - phthalimide - picric acid - P- nitro-acetanilide, etc.)

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20%
- Assignments and classroom activities: 30%
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- كيمياء المنتجات الطبيعية – الجزء النظري, أ.د. طاهر حسن, جامعة البعث, مديرية الكتب المطبوعات الجامعية
- Chemistry of Natural Products, S. V. Bhat, B. A. Nagasampagi, S. Minakshi, Springer, 2005

(7) Reference Books

1- - Chemistry of Natural Products, Ayodhya Singh, Campus Books International, 2004
2- Natural Products Isolation, S. D. Saker, Z. Latif, A. I. Gray, 2nd ed., Humana Press, Totowa, New Jersey, 2006.

22- Kinetic Chemistry 342 CHEM-4

Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Kinetic Chemistry	**342CHEM-3**	**2**	**2**	**3**	**3rd**	**5th**	**----**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	30	HW/Assignments	15
Laboratory	30	Case studies	0
Exams and quizzes	12	Study for Exam	14
Lab demo	30	Working on lab experiment	30
		Preparation for classes	30
Total	**85.00**	Total	**89.00**
Total Learning Hours	174.00	Equivalent **ECTS points** = (Total LH/28)	6.21

(1) Brief Course Description

This course covers the *principles of kinetic chemistry***.**

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1- *The laws of reaction rate for different chemical reactions,*
2- *Temperature effect on the reaction rate and Arrhenius equation.*
3- *Collision theory of unimolecular and bimolecular reaction.*

(3) Course Contents

1A- Theoretical:

*General concepts of kinetic chemistry; rate of reaction and factors affecting it, the reaction rate constant, order and Molecularity, pseudo-order reactions, the rate equations and half-life period- The derivation of the different rate laws and half-life period, zero, 1st, 2nd, and 3rd order reactions- Determination of the order of the reaction; integration, graphical, half-life period, Van'tHoff's differential and Ostwald isolation method-Rate laws for complex reactions; parallel, consecutive and chain reactions-Temperature effect on reaction rate- Derivation of Arrhenius equation-Determination of the activation energy of the chemical reactions – Effect of the catalyst on the activation energy-Reaction rate theories; Collision theory and Transition state theory***.***

B- Practical

Experimental work illustrating selected parts of the theoretical content.

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20%
- Assignments and classroom activities:30%
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Atkins' Physical Chemistry 11e: Volume 1: Thermodynamics and Kinetics, 2018

(7) Reference Books

1- *Chemical Kinetics and Reaction Dynamics,* 1st edition, *Paul L. Houston, 2006.*
2- *Chemical Kinetics and Reaction Dynamics, Santosh K. Upadhyay, Springer, 2006, ISBN 1-4020-4546-8 (HB) - ISBN 1-4020-4547-6 (e-book)*
3- *Principles of Chemical Kinetics,* 2nd edition, *James E. House, 2007.*

23- Principles of Biochemistry 439 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Principles of Biochemistry	439CHEM-3	2	2	3	4th	8th	-----

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	12
Laboratory	30	Case studies	0
Exams and quizzes	10	Study for Exam	20
Lab demo	15	Working on lab experiment	30
		Preparation for classes	30
Total	70.83	Total	92.00
Total Learning Hours	162.83	Equivalent **ECTS points** = (Total LH/28)	5.82

(1) Brief Course Description

This course covers the basic principles and definition of biochemistry, structure, functions, and a general idea of metabolic reactions, and biological functions of proteins, amino acids, enzymes, and Nucleic acids. Carbohydrates studies and their function and Glucose oxidation to get energy. Lipids and their biological importance

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Biological fluids and metabolic reactions (catabolic and anabolic)
2. Nucleic acids, their structure and functions (DNA and RNA).
3. Enzymes classification, regulation, factors affecting enzyme action.
4. The importance of biochemistry in our life.

(3) Course Contents

A- Theoretical:

General introduction to the study of bio-molecules – biological fluids – metabolic reactions (catabolic and anabolic) – production of bioenergetics – structure, and function of macro bio-molecules, including proteins, amino acids, enzymes, and carbohydrates (monosaccharides, disaccharides, and polysaccharides) – Biological oxidation of glucose to obtain energy - lipids – classification and biological importance – structure and function of lipids - Fatty acids – beta-oxidation of fatty acids to obtain energy – nucleic acids; structure and function - DNA and RNA, structure and function.

B- Practical

Selected experiments related to Biochemistry analysis5.

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20%
- Assignments and classroom activities:30%
- Final Exam:50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1- - Lehninger, Principles of Biochemistry (sixth edition) by David L. Nelson Michafi M. Cox. W. H. FREEMAN AND COMPANY. New York. 2013
2- Concise Text of Biochemistry. T.N Pattabiraman, 3rd Ed, 2001.

(7) Reference Books

1- اسس الكيمياء الحيوية. الدكتور عبد المنعم الاعسر , المجلد الاول, المكتبة الاكاديمية 2011
2- Textbook-of-Biochemistry-For-Medical-Students-6th-Edition.pdf (online)

24- Methods of Instrumental Analysis 415 CHEM-4

Course Title	Course Code	Number of Study Hours			Year	Level	Pre-requisites
		Theo.	Lab.	Credit			
Methods of Instrumental Analysis	**415CHEM-4**	**3**	**2**	**4**	**4th**	**8th**	**314CHEM-3**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	45	HW/Assignments	20
Laboratory	30	Case studies	0
Exams and quizzes	20	Study for Exam	25
Lab demo	15	Working on lab experiment	30
		Preparation for classes	45
Total	**91.67**	Total	**120.00**
Total Learning Hours	211.67	Equivalent **ECTS points** = (Total LH/28)	7.56

(1) Brief Course Description

This course covers the basic principles of methods of instrumental analysis and their applications

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Recognizing the Electromagnetic Radiation.
2. Recognizing the Molecular Ultraviolet and Visible Absorption Spectroscopy.
3. Recognizing the infrared spectroscopy, Spectrum of IR, and IR Instrumentation.
4. Recognizing the Atomic and emission Spectrometry as well as NMR, MS,, and X-ray spectroscopy

(3) Course Contents

A- Theoretical:

Spectroscopic methods: Introduction to electromagnetic radiation and molecular transitions, UV- and visible radiations and spectrophotometer, Laws of spectral absorption, Fluorimetry, Infra-red spectrometer, atomic absorption and atomic emission spectrometers, NMR spectrometer, Mass spectrometry, X-ray absorption and fluorescence

B- Practical

Selected experiments related to instrumental analysis

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 30 %
- Assignments and classroom activities: 20 %
- Final Exam:50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Douglas A. Skoog, F James Holler, and Stanley R. Crouch, Principles of instrumental analysis, (2016) 7th edition Thomson Brooks/Cole.

- د. سلامة أحمد خميس محمد (المطيافيات بين النظرية و التطبيق) جامعة المجمعة- الطبعة الأولى– 2010(143)

(7) Reference Books

– د. إبراهيم الزامل(التحليل الآلي) – دار الخريجي- الطبعة الثالثة 1998

25- Quantum Chemistry 447 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Quantum Chemistry	**447CHEM-3**	**3**	**0**	**3**	**4th**	**7th**	**202MATH-3**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	45	HW/Assignments	20
Laboratory		Case studies	20
Exams and quizzes	20	Study for Exam	25
Lab demo		Working on lab experiment	
		Preparation for classes	45
Total	**54.17**	Total	**110.00**
Total Learning Hours	164.17	Equivalent **ECTS points** = (Total LH/28)	5.86

(1) Brief Course Description

This course covers the basic principles of f quantum theory and its applications in some chemical systems

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. learning the nature of the classical mechanics as well as its failure to describe microscopic particles
2. learning the historical development of the quantum theory and its postulates
3. application of quantum theory for H-atom as an Example of simple chemical systems

(3) Course Contents

A- Theoretical:

classical mechanics – black body radiation and photoelectric effect – Hydrogen electronic spectra – Compton-effect – De Broglie relation and dual nature of microscopic particles- Schrödinger equation- solution of SE for a particle in one (two and three) dimensional box – solution of SE for rigid rotor – solution of SE for harmonic oscillator – solution of SE for H-atom.

B- Practical

none

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 30 %
- Assignments and classroom activities: 10 %
- Final Exam: 60 %

(5) Course Tea vching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1. Molecular Quantum Mechanics, Atkins PW, Friedman RS 4th ed. Oxford: Oxford University Press; 2005.

(7) Reference Books

Quantum Chemistry: A Unified Approach, David B. Cook, 2nd Edition, imperial College Press; 2012**.**

26- Surface Chemistry& Catalysis 343 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Surface chemistry & Catalysis	**343CHEM-3**	**3**	**0**	**3**	**3rd**	**5th**	---------

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	45	HW/Assignments	25
Laboratory		Case studies	15
Exams and quizzes	20	Study for Exam	20
Lab demo		Working on lab experiment	
		Preparation for classes	45
Total	**54.17**	Total	**105.00**
Total Learning Hours	159.17	Equivalent **ECTS points** = (Total LH/28)	5.68

(1) Brief Course Description

This course covers the knowledge about catalytic reactions, catalysts, and their different applications, and colloids also studying surface chemistry and adsorption, especially on solid surfaces.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Identification of different catalytic process
2. Identification of catalyst and its role and effect on the chemical reaction
3. Identification of different catalytic theories.
4. Identification of gas adsorption on solid surfaces.

(3) Course Contents

A- Theoretical:

Adsorption and its type, factors affecting it, Gibbs and Langmuir's theory for adsorption and its application on the surface area, and calculations concerning them. Intermediate compounds and adsorption theories. Homogeneous and heterogeneous catalysis, (Enzymes), Colloids, their type, methods of preparation and their properties, theories for catalysis applications on the chemical process, and heterogeneous catalyst

B- Practical

none

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 30%
- Assignments and classroom activities: 10 %
- Final Exam: 60 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

1. Physical Chemistry, James Keeler 11th .Ed.(2018) J.de Paula & P. Atkins.
2. R. I. Masel, "Principles of Adsorption and Reaction on Solid Surfaces", Wiley Series in Chemical Engineering, Wiley-Interscience, New York, USA, 1996, ISBN 978-0-471-30392-3

(7) Reference Books

1. *مبادئ الكيمياء الفيزيائية المطورة الطبعة الثانية، دار المعارف القاهرة ا.د. محسن الصباح ا.د. السيد علي حسن 1999*

2. -Handbook of Surface and Colloid Chemistry, Third Edition by K. S. Birdi 20, 2008.
3. -Essentials of Physical Chemistry, Arun Bahl, 26th. Ed (2018) B.S. Bahal, G.D. Yuli.

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27- Electrochemistry 344 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Electrochemistry	**344CHEM-3**	**2**	**2**	**3**	**3rd**	**6th**	**------**

In-class activities		Self-learning/study	
	Contact Hours		Hours
Lectures	30	HW/Assignments	14
Laboratory	30	Case studies	
Exams and quizzes	10	Study for Exam	15
Lab demo	15	Working on lab experiment	30
		Preparation for classes	30
Total	**70.83**	Total	**89.00**
Total Learning Hours	159.83	Equivalent **ECTS points** = (Total LH/28)	5.71

(1) Brief Course Description

This course covers students the basic principles of electrochemistry and its applications

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Types of conductors
2. Classification of electrolytic cells
3. Measuring EMF
4. Applications of electrochemistry

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(3) Course Contents

A- Theoretical:

Electrolytic conductors, General electrochemistry concepts, Introduction to electrochemistry: electrode potentials, galvanic and electrolytic cells, Nernst equation, Corrosion and corrosion protection, Overview of applications of electrochemistry

B- Practical

Experimental work illustrating selected parts of the theoretical content

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20 %
- Assignments and classroom activities: 30 %
- Final Exam: 50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Handbook of Electrochemistry, 2007, Cynthia G. Zoski, Elsevier

(7) Reference Books

1. Electrochemistry, 2nd Edition, P.H. Rieger, Springer, 1993
   ISBN: 0412043912,9780412043918

2. Electrochemistry and Corrosion Science, Nestor Perez, 2016, Springer International Publishing, ISBN: 978-3-319-24845-5,978-3-319-24847-9

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28- Group Theory 425 CHEM-2

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Group Theory	**425HEM-2**	**2**	**0**	**0**	**4th**	**8th**	--------

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	30	HW/Assignments	15
Laboratory		Case studies	15
Exams and quizzes	15	Study for Exam	10
Lab demo		Working on lab experiment	
		Preparation for classes	30
Total	**37.50**	Total	**70.00**
Total Learning Hours	107.50	Equivalent **ECTS points** = (Total LH/28)	3.84

(1) Brief Course Description

This course covers ***the principles of symmetry and group theory, laws, and their applications in chemistry.***

(2) Course Objectives

This course has been designed to provide students with the following concepts:

2. Recognizing the elements of symmetry and point groups.
3. Recognizing the reducible and irreducible representations.
4. Recognizing the vibrational spectroscopy.
5. Recognizing the infrared absorption bands and Raman lines

(3) Course Contents

A- Theoretical:

Elements of symmetry and point groups – Reducible and irreducible representations – Character tables – Vibrational spectroscopy – Infrared absorption bands and Raman lines – Bonding in transition elements complexes – Spectra of octahedral, tetrahedral, and square planar complexes

B- Practical

None

(4) Assessment Criteria

- Mid Term Exam and Quizzes:30 %
- Assignments and classroom activities: 10 %
- Final Exam: 60 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Inorganic Chemistry, 5th Edition by Gary L. Miessler, Paul J. Fischer, Donald A. Tarr, (2013)

(7) Reference Books

Molecular Symmetry and Group Theory: A Programmed Introduction to Chemical Applications, 2nd Edition by Alan Vincent (2001)

29- Photochemistry 448 CHEM-2

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Photochemistry	**448CHEM-2**	**2**	**0**	**2**	**4th**	**8th**	**----**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	30	HW/Assignments	15
Laboratory		Case studies	15
Exams and quizzes	20	Study for Exam	15
Lab demo		Working on lab experiment	
		Preparation for classes	30
Total	**41.67**	Total	**75.00**
Total Learning Hours	116.67	Equivalent **ECTS points** = (Total LH/28)	4.17

(1) Brief Course Description

This course covers the basic principles of photochemistry and its chemical and biological applications.

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Laws of photochemistry
2. Experimental methods in photochemistry
3. Mechanisms of photochemical reactions
4. The applications of photochemistry

(3) Course Contents

A- Theoretical:

Basic principles of photochemistry: Laws of photochemistry- Beer-lambert law - Fluorescence and phosphorescence- Photochemical reactions and quantum yield- Mechanisms of photochemical reactions- Experimental methods in photochemistry- The applications of photochemistry.

B- Practical

None

(4) Assessment Criteria

- Mid Term Exam and Quizzes: 30 %
- Assignments and classroom activities: 10 %
- Final Exam: 60 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- Principles and Applications of Photochemistry, R. P. Wayne, 2009, John Wiley & Sons, Ltd, ISBN 978-0-470-01493-6.

(7) Reference Books

- Photochemistry; C. E. Wayne & R. P. Wayne, 1996, OUP primer
- Photochemistry, Past, Present and Future; Angelo Albini, Springer-Verlag Berlin Heidelberg 2016, ISBN 978-3-662-47976-6

30- Solution Chemistry 445 CHEM-3

Course Title	Course Code	Number of Study Hours			Year	Level	Pre- requisites
		Theo.	Lab.	Credit			
Solution Chemistry	**445CHEM3**	**2**	**2**	**3**	**4th**	**7th**	**----**

In-class activities		Self-learning/study	
	Contact Hours		**Hours**
Lectures	30	HW/Assignments	10
Laboratory	30	Case studies	
Exams and quizzes	15	Study for Exam	20
Lab demo	15	Working on lab experiment	30
		Preparation for classes	30
Total	**75.00**	Total	**90.00**
Total Learning Hours	165.00	Equivalent **ECTS points** = (Total LH/28)	5.60

(1) Brief Course Description

This course covers the basic information about Solution chemistry, Debye Huckel theory, conductivity measurements and its application, Transport numbers, and Ion association

(2) Course Objectives

This course has been designed to provide students with the following concepts:

1. Become acquainted with the theory and assumptions of Debye-Hückel
2. Become acquainted with the electrolytic conductivities and their applications
3. Become acquainted with the theory of diffusion and transport numbers and implications
4. Identify the Ion Association and the various theories that have addressed ion association

(3) Course Contents

A-Theoretical contents

Debye – Hückel theory, Concentration and activity, Electrolytic conductance, Ionic association, Properties of electrolytic conductance, diffusion theory, Transport numbers, Theories of ion association, Bjerrum theory, Brönsted theory, Fuoss theory, Different methods for measurements of ion association.

Syllabus: A-Practical contents

Experimental work illustrating selected parts of the theoretical content

(4) Assessment Criteria

- Mid Term Exam and Quizzes:20 %
- Assignments and classroom activities:30 %
- Final Exam:50 %

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) Text Book

- An Introduction to Aqueous Electrolyte Solutions, by Margaret Robson Wright Formerly of St Andrews University, UK. Willy 2007.

(7) Reference Books

Essentials Of Physical Chemistry. Bahl A., et al. S.Chand. 2010, English. 4ed. 1166\1166. 1122910

Approval

HEAD OF DEPARTMENT	**DR. WALID BIN MOHAMMED YAHYA ALAMEER**
SIGNATURE.	
DATE	**24/10/2023G – 09/04/1445H**