

Handbook Of  
Chemistry Department

2018





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**Dr. Abdullah Ali Al-Kahtani**  
Chairman of Chemistry Department

The Education in our beloved Kingdom, and higher education in particular is in its most important phase of its history, which seeks to keep pace with the global movement in this area, and to ensure quality in its programs and its outputs. King Saud University, took the initiative and leadership to this movement, represented by its management, its centers of quality, colleges and various academic departments. **The department of Chemistry**, is at the forefront of university departments, in its distinguished qualified staff, both in terms of academic, research, and contributions in the service of the university and the community. The department of Chemistry has developed its academic programs and has attracted a number of distinguished researchers from around the world. It became one of the first five departments at the university, in the scientific publishing. It also sought to attract talented students who wish to pursue their higher studies.

# Chemistry Department



## About the department

The Chemistry Department was established in the year of 1378 H (1957 G) when the College of Science was founded. The Chemistry Department is the biggest department not only at the College level, but also at the University level. It is considered as a services department for several colleges, such as Engineering, Science of food and agricultural, Education and Health Sciences.

The Department includes 76 faculty members (males and females), and about 63 support staff (Males and Females). Also, the Department houses 35 research laboratories (for males and females) which contain many analytical instruments and analysis equipment. The Department consists of five chemistry specializations; namely:

- 1- Inorganic
- 2- Organic
- 3- Physical
- 4- Analytical
- 5- Polymer science (M.Sc. degree).

The Chemistry Department contains two Postgraduate Programs; namely, a Master's Program which was established in 1400 H (1980 G), and a Ph.D. Program which was established in 1415 H (1995 G). In general, the Chemistry Department confers several academic degrees which include B.Sc., M.Sc., M.Sc. in polymer science, and Ph.D.

The staff of the Department's faculty members have been involved actively in authoring books and research papers. The number of books, which have been authored by the faculty members, has reached about 90 books in different disciplines of chemistry. In the field of research papers, the Department's faculty members have published more than 500 papers. All papers were published in highly respected and strictly refereed international as well as regional journals. In addition to that, some of the faculty members are cooperating with some governmental and private agencies as part-time consultants.

The Chemistry Department is actively involved in numerous activities which are of valuable interest to the industrial sectors as well as to the academics. Such activities include the presentation of lectures, holding workshops and conferences in the field of chemistry. Also, there are strong ties between the Chemistry Department and the Saudi Chemical Society.

The chemistry department has a Females' Branch which was established in 1402 H (1982 G). This Branch has 24 faculty members and 18 support staff. Also, it contains several teaching and research laboratories. All laboratories are equipped with all necessary analytical tools and teaching equipment.





## Vision

Leadership in chemistry and its applications for contributing in building knowledge society.

## Mission

To provide high quality education, research, and training with practical experience in Chemistry that is responsive to enhance the knowledge-based economy.

## Goals

**Goal 1:** Achieving excellence in Chemistry education

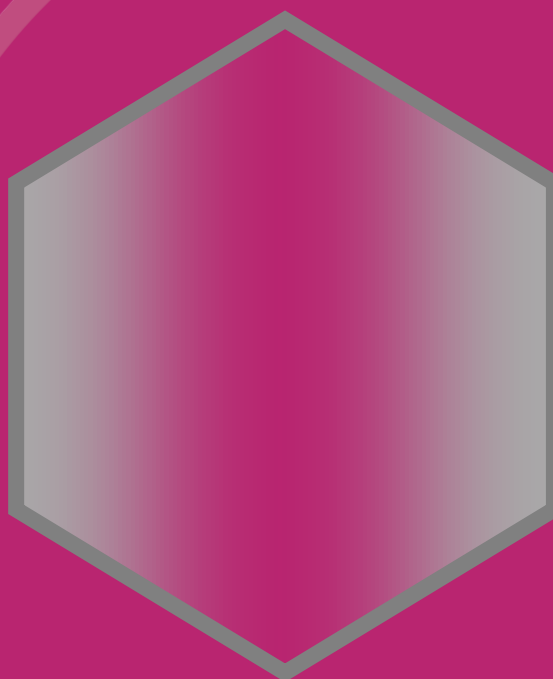
**Goal 2:** Fostering attractive academic and research environment for distinguished faculty members, staff and students.

**Goal 3:** Preparing students to have excellent knowledge sought by employers.

**Goal 4:** Providing the scientific community with high impact research.

**Goal 5:** Promoting Chemistry culture by participating in professional organization.

# BSc. Program in Chemistry



## Program Information

Department of Chemistry was founded in 1378-1379 H. (corresponding to 1958/1959 A.D.) with the foundation of College of Science, which is one of the oldest colleges at King Saud University and was the first scientific college in the Arabian Peninsula.

Chemistry program was established to provide the Kingdom with scientific leaders in the different sectors and to:

### Technological development reasons:

- Providing highly qualified specialists for the development of chemical industries in the Kingdom.
- Preparing chemists for serving the industrial development in petroleum, petrochemical, pharmaceutical, mining, food, detergents and other chemical industries.
- Preparing qualified specialist for chemical research and development laboratories.

### Social reasons:

- Preparing leaders for kingdom sustainable development.
- Providing specialists in safety awareness on health hazards and proper use of chemicals and environmental protection.
- Supporting basic sciences lifelong learning ensuring continued intellectual growth and welfare of society.

**Relevance of the program to the mission and goals of the KSU:**

- Providing other scientific disciplines with the basic knowledge needed for their professions; e.g. medical, engineering and agricultural students.
- Providing leaders for social development, professionalism, responsibility, and innovation in Chemistry based sectors.

## **Professional occupations graduates are prepared for:**

- Administrator, laboratory specialist, Research assistant
- (Ministry of Education)
- Forensic science lab officer at “Ministry of Interior” and “National Guard”
- Specialist at quality labs: Saudi Standards, Metrology and Quality Organization.
- Lab specialist at “Food & Drug Administration”
- Researcher in research labs at “King Abdul-Aziz City for Science and Technology” and SABIC
- Specialist at chemical and petrochemical industries.
- Chemists at Government and private sectors.
- High school Teacher, laboratory expert at Ministry of Education”

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## **BSc. Program Learning Outcomes:**

### **1.0 Knowledge**

- 1.1 To describe the fundamental concepts and principles of chemistry.
- 1.2 To recognize the basic theories of chemical methods and techniques.
- 1.3 To define and reproduce scientific information about chemical topics.

### **2.0 Cognitive Skills**

- 2.1 To integrate and evaluate chemical information and data from in order to gain a coherent understanding of theory and practice.
- 2.2 To analyze, interpret and chemical data by linking chemical and physical concepts with mathematical expressions.
- 2.3 To propose and apply creative solutions to chemical problems with limited guidance.
- 2.4 To develop applications of chemical concepts to other areas of science, technology, and industry.

### **3.0 Interpersonal Skills & Responsibility**

- 3.1 To apply team-working skills to address chemistry problems and coordinate effectively whether in a leadership role or as a member of group.
- 3.2 To demonstrate self-learning ability for finding needed chemical information or technique.
- 3.3 To use code of practice on how to manage the risks associated with hazardous chemicals in the workplace

### **4.0 Communication, Information Technology, Numerical**

- 4.1 To communicate effectively in oral and written formats in order to present scientific chemical issues for different audiences.
- 4.2 To employ developed information and communications technology in gathering and interpreting chemical information and ideas.

### **5.0 Psychomotor**

- 5.1 To demonstrate appropriate safety techniques and proper use of lab materials and equipment.

# Admission

## Admission to the BSc. Program:

Admission to the College is subject to the following requirements:

- 1) The applicant must have the Saudi High school Certificate (Science Section) or an equivalent diploma.
- 5) After finishing the Preparatory Year, the student should fulfill the following GPA requirement.

GPA (2.25)	Conditions (From preparatory year)
2.2 - 2.5/5	With grade C in CHEM 101.
2.5 - 2.75/5	With grade D+ in CHEM 101.
2.75 - less than 3/5	With grade D in CHEM 101.



# The Study System at the College of Science

Teaching at the College of Science is subject to the following scheme:

1. The school year consists mainly of two regular semesters and a summer semester, if available.
2. The stage of academic progress is indicated by the academic level since the number of levels to graduate is at least eight levels in conformity with the approved Study Plan.
3. The duration of the level is a full semester (not less than 15 weeks) and this period does not include the periods of registration and final exams.
4. The duration of the summer semester is not less than eight weeks where the teaching time allocated for each course is doubled.
5. A number of courses (subjects) are taught during each academic level according to the program of each specialty in the different departments.
6. Students have to study 136 class units (credit hours) to obtain a Bachelor's Degree as follows:
  - A. The student studies a number of 31 credit hours during the Preparatory Year (two semesters in one academic year).
  - B. The student studies 97 credit hours (optional + compulsory) in the Program of Specialization in the various College departments throughout the six semesters following the Preparatory Year (beginning with the third semester).
  - C. University Requirements: The student selects 8 credit hours of the requirements of the University out of 22 optional credit hours during the period of study at the College.
7. The student chooses the specialty department before the end of the Preparatory Year based on the conditions set by each department.

## The New Academic System (e-Register)

Registration is the cornerstone of the academic system, the center of the educational process, and the first step to start university life. The new Academic System (e-Register) offers new students the following opportunities:

1. To create an e-mail through the site of the Deanship of Electronic Transactions and Communications: <http://www.ksu.edu.sa/sites/KSUArabic/Deanships/Computer/Pages/>.
2. To have an access to the academic system by using the link: <http://edugate.ksu.edu.sa>; then, entering a user name and a password.
3. Online Registration (registration, adding, and dropping): a student can register, in person, from any location during the periods of registration and dropping plus an additional period specified in the academic calendar; thus, without having to visit the College or the Department, the student can perform the following:
  - A. Registration: Registration of courses and deciding the required number of credit hours.
  - B. Adding and dropping: The student may drop and add courses during the first week of teaching provided that the study load does not go above, or lower than, the allowed course load.
4. To view the course schedule of the College and the available/closed groups.
5. To view the study schedule and print it.
6. To view the Academic Record and print a copy (an unofficial copy).
7. To view the results of the final exams as soon as they are put online.
8. To view the Study Plan, the courses passed by the student, and the ones remaining to be studied.
9. To know about the penalties imposed upon the student.
10. To view the financial rewards.
11. To make suggestions and submit complaints.
12. To write the academic performance evaluation of faculty members.
13. To exchange electronic messages and change the password.

\* In case of any problem while registering, please consult the College Registration Office (room 1A7 - Building 4).

## Rules and Mechanisms for Registration of Courses

- The Course is a module that meets the needs of the level specified in the approved Study Plan in each specialty (Program). The Course has a number, a code, a title, and a description depending on the different departments (see the Department's Manual Guide).
- The Course is divided into a set of theoretical lectures and practical lessons (study units) taught weekly during the academic level.
- The Credit Hour is a weekly theoretical lecture that is not less than fifty minutes, or a practical lesson which is not less than one hundred minutes.
- The registration of the courses for all students is done automatically through the website: <http://edugate.ksu.edu.sa>
- The academic levels vary in the number of the units of study, from 12 units to 20 units, for each level.
- The Courses are registered automatically at the beginning of the following semester for the student's convenience. Then, the student can modify the course schedule by adding or dropping.
- The following table shows the student's study load corresponding to the cumulative average:

GPA	2	2.5	3	3.5	4	4.5	5
Hours allowed for registration	14	15	16	17	18	19	20

- The Processes of dropping and adding are performed by the student electronically in the first week of the semester through accessing the gate of the academic system of the University Deanship of Admission and Registration (<http://edugate.ksu.edu.sa>).
- No student has the right to register a course without passing its pre-requisite course.
- Students, who pass all courses without failures, are registered in the courses of the level beginning gradually with the lower levels according to the study plans approved.
- Students, who fail in some courses, are registered in courses that ensure their minimum study load in each semester taking into account the following points:
  - No conflict in the course study schedule.
  - Satisfying the previous requirements of the course or courses to be registered.

## Calculating the Average and Cumulative GPA

The Average and cumulative GPA are calculated every semester for the student automatically by the system. To know how to calculate the averages, you should follow the following steps:

### Calculating the Semester Average:

The GPA is calculated considering the following points:

1. Knowing the number of hours of the courses.
2. knowing the mark obtained in each course.
3. Knowing the corresponding grade of each mark.
4. Knowing the value of each grade.
5. Knowing the points = number of hours of the course  $\times$  value of the grade.
6. Determining the total points obtained in all courses of the semester.
7. Determining the total number of hours registered in the semester.
8. The average is calculated every semester according to the following equation:

GPA =	Total points (item 6)
	Number of hours registered in the semester (item 7)

The following table shows the percentage of marks, grade and value obtained by the student in each course, which is used to calculate the points:

Mark	Grade	Letter of Grade	Value of Grade
From 95-100	+ Excellent	+A	5.00
From 90 to less than 95	Excellent	A	4.75
From 85 to less than 90	+Very Good	+B	4.50
From 80 to less than 85	Very Good	B	4.00
From 75 to less than 80	+ Good	+C	3.50
From 70 to less than 75	Good	C	3.00
From 65 to less than 70	+ Pass	+D	2.5
From 60 to less than 65	Pass	D	2.00
Less than 60	Failure	E	1.00
(Absence from lectures (25% or more	Debarred	H	1.00

## Calculating the Average Cumulative:

The GPA semester average is calculated as follows:

- 1) The grand total of points (for all semesters that have been studied).
- 2) The grand total of credit hours (for all semesters that have been studied).
- 3) The cumulative average is calculated according to the following equation:

GPA =	Grand total of points
	Grand total of credit hours

Here is an example of how to calculate the grades above:

Calculating the grade of the first semester:

Course	Credit Hours	Mark	Grade	Grade Value	Points
Phys 101	4	67	D+	2.5	$4 \times 2.5 = 10$
Chem101	4	73	C	3	$4 \times 3 = 12$
Eng 121	3	77	C+	3.5	$3 \times 3.5 = 10.5$
Arab 101	2	81	B	4	$2 \times 4 = 8$
	13				40.5
$\text{GPA} = \text{Total points} \div \text{No. of hours registered in semester} = 40.5 \div 13 = 3.12$					

### Calculating the grade of the second semester:

Course	Credit Hours	Mark	Grade	Grade Value	Points
Math 101	3	61	D	2	$3 \times 2 = 6$
Stat 101	3	73	C	3	$3 \times 3 = 9$
Computer Science 206	3	80	B	4	$3 \times 4 = 12$
Arab 103	3	88	B+	4.5	$3 \times 4.5 = 13.5$
Islam 101	2	92	A	4.75	$2 \times 4.75 = 9.5$
Eng 122	3	97	A+	5	$3 \times 5 = 15$
	17				65
GPA = Total points $\div$ No. of hours registered in semester = $65 \div 17 = 3.82$					

Calculating the average cumulative:

$$\text{GPA} = \text{Total points} \div \text{Total hours of the semester} = 105.5 \div 30 = 3.52$$

### Dropping and adding of a course:

1. The process of dropping and adding is performed through portal (<http://edugate.ksu.edu.sa>) during the first week of the semester only; but the number of credit hours registered has to be at least 12 hours.
2. The student may drop only one course due to an excuse acceptable to the Dean of the College. This procedure should occur at least five weeks before the final exams begin. The student has the right to apply for such a procedure at a maximum of four courses during the whole period of study at the College.

## Attendance, postponing and dropping out of College:

- The student must be regular in attendance attending at least 75% of the lectures and the practical classes.
- If any student has a percentage of absence of 25%, or more, in any course, he is denied access to the final exam of this course and his result is F.
- A student may apply for postponement of the study before the beginning of the semester for an excuse accepted by the College Board. The postponement should not exceed two consecutive semesters or three intermittent semesters as a maximum limit while studying at the College.
- The University Council may, in case of necessity, exempt the applicant from the previous provision.
- If a student drops out of College for one semester without requesting the postponement of his registration, the University has the right to dismiss his registration. The University Council has the right to do this for a lesser period of time.
- The student is not considered as dropping out of College if he is a visiting student at another university.

## Visiting Student:

The Visiting Student is a student who studies some courses at another university, or at a branch of the university to which he belongs without being transferred. The courses he studied are accredited according to the following regulations:

- The student has to have a transcript (including a grade point average) for, at least, two semesters at his college before he applies as a visiting student.
- The student must obtain a prior approval from his college permitting him to study as a visiting student while specifying the courses that will be studied. The College has the right to require a specific grade to be achieved by the student to offset the course. The student should obtain an official letter from the Deanship of Admission and Registration directing him to study as a visiting student.
- The student has to join an officially recognized college or a university.
- The courses, under consideration by the student to be studied outside the University, must be equivalent in their description to the University courses, and their course

units should be no less than the units of any of the courses contained in the graduation requirements.

- The maximum of the total units of study that can be calculated from outside the University is twenty percent (20%) of the total units required for graduation at King Saud University.
- The courses that are studied by the visiting student are not included in the cumulative average. These courses are recorded in his academic record.
- The student must provide the Deanship of Admission and Registration with the results he obtained during the first two weeks of study in the semester following the period of study as a visitor. If not reported within that period, the student is considered as dropping out of College during those semesters.

## **Dismissal from the University:**

The student is dismissed from the University in the following cases:

- If he receives three consecutive warnings due to a cumulative average below a minimum of 2.
- The student may be given a fourth opportunity by the Council of the University based upon the recommendation of the College Council to raise his cumulative GPA by studying the available courses.
- The University Council may give the dismissed students, due to warnings, an opportunity that does not exceed two semesters as a maximum.
- If the student does not fulfill his graduation requirements at the College in a period of up to half of the period prescribed for graduation in addition to the duration of the Program.
- The student is given an exceptional opportunity by the University Council to meet the graduation requirements during a maximum period not exceeding twice the original term specified for graduation.
- The University Council may allow dismissed students, due to the exhaustion of failure times, to attend twice the duration of the Program. This extension should not exceed a maximum of two semesters.



## Examinations and Grades:

- Based on a proposal from the Department Council, the College Council specifies a mark for the student's semester work, varying from 40% to 60% of the final grade of the course.
- The mark of the course's semester work is calculated by one of the following two methods:
  - Oral, practical tests, research, or other forms of classroom activity, or from all the above or some of them, in addition to at least one written exam.
  - Two written exams at least.
- Based on the recommendation of the course teacher, it is permissible for the Council of the Department, that teaches the course, to allow the student to complete the requirements of any course in the following semester and to give the student a grade of I (incomplete) in his academic record. Only the grades achieved by the student are included in the GPA or cumulative after the completion of the requirements of that course.
- If one semester passes without changing the grade incomplete (I), the student is given an F which is calculated in the GPA and cumulative.
- The grades obtained by the student in each course are calculated according to the schedule mentioned above.

## Restrictions of the Final Examinations:

1. No student may be tested in more than two courses in one day.
2. The student is not allowed to enter the final exam after half an hour of its beginning, and is not allowed to leave the exam room before half an hour after its beginning.
3. Based on a recommendation from the relevant Department Council, the College Council specifies the duration of the final written exam to be within a period not less than one hour, and not more than three hours.
4. Cheating in the exam, initiating it, or violating the instructions and rules of examination procedures are actions punishable in accordance with the Regulations of the Students' Discipline issued by the University Council.

5. In cases of necessity, the College Council, in charge of teaching a course, has the right to approve re-marking of the answer sheets in a period of time not later than the beginning of the following semester in accordance with the following rules:
  - A student may apply for re-marking the answer sheets of only one course per semester.
  - The student, who wishes to re-mark his answer sheets, may apply for re-marking to the department, that teaches this course, not later than one month after taking the final exam.
  - A student, who has already applied for re-marking and proved the invalidity of his application, should never apply for re-marking his answer sheets in any exam in the future.

## **Transferring:**

### **1) Transferring from one college to another within the University:**

- It is permissible, with the consent of the respective deans of the colleges, to transfer from one college to another in accordance with the conditions approved by the College Council to which the student wishes to transfer.
- The student's college academic record has to show all courses previously studied, including grades, semester and cumulative averages throughout the study at the college from which he is transferred.

### **2) Transferring from one major to another within the College:**

- The student may, after the approval of the Dean, transfer to another specialty within the College according to the guidelines established by the College Council.
- The student's college academic record has to show all courses previously studied, including grades, semester and cumulative averages throughout the study at the college from which he is transferred.

## **Graduation:**

The student graduates after completing successfully the graduation requirements in accordance with the study plan, provided that his cumulative average is no less than 2 (Pass).





# Study plan for B.Sc Program

Student must complete (136) credit units as follows:

\* Credits: (Practical – Exercise –Lecture)

First Level				Second Level			
Course	Name	.Prereq	Units	Course	Name	.Prereq	Units
ENGL 104 or ENGL 105 or ENGL 106	English Language	None	6	ENGL 111 or ENGL 112 or ENGL 113	Specialized English Language	None	6
MATH 101	Calculus	None	3	UNIV 101	University skills	None	3
ENT 101	Entrepreneurship	None	1	TECH 101	Computer skills	None	3
CHEM 101	General Chemistry	None	4	STST 101	Introduction to Statistical	None	3
ARAB 100	Writing skills	None	2	HEL 101	Health & Fitness	None	1
<b>Total</b>			<b>16</b>	<b>Total</b>			<b>16</b>
Third Level				Fourth Level			
Course	Name	.Prereq	Units	Course	Name	.Prereq	Units
MATH 211	Mathematics for Chemists	None	(0+2+3) 3	PHYS 101	General Physics (1)	None	(2+0+3) 4
CHEM 201	General Chemistry )2(	CHEM 101	(2+0+3) 4	CHEM 223	CHEM. of Main Groups	CHEM 201	(0+0+3) 3
CHEM 240	Organic Chemistry )1(	CHEM 101	(0+0+2) 2	CHEM 232	Chemical thermodynamics	MATH 211 CHEM 201	(2+0+2) 3
CHEM 247	Identification of .Organic comp	CHEM 101	(4+0+0) 2	CHEM 241	Organic Chemistry )2(	CHEM 240	(0+0+2) 2
CHEM 252	Fundamentals of Analytical Chemistry	CHEM 101	(2+0+2) 3	CHEM 256	Spectroscopic Analytical Methods	CHEM 252	(2+0+2) 3
University requirement From (group A)		None	(0+0+2) 2	University requirement From (group A)		None	(0+0+2) 2
<b>Total</b>			<b>16</b>	<b>Total</b>			<b>17</b>
Fifth Level				Sixth Level			
Course	Name	.Prereq	Units	Course	Name	.Prereq	Units
CHEM 323	.CHEM of Transition Elements	CHEM 223	(0+0+3) 3	CHEM 320	Quantum Chemistry )1(	CHEM 201 MATH 211	(0+0+2) 2
CHEM 330	Physical Chemistry of Polymers	CHEM 232	(2+0+1) 2	CHEM 329	Inorganic Compounds Spectroscopy	CHEM 323	(0+0+2) 2
CHEM 335	Chemical Kinetics	CHEM 232	(2+0+2) 3	CHEM 336	Physical Chemistry of Solutions	CHEM 232	(2+0+2) 3
CHEM 344	Organic Reaction Mechanism	CHEM 241	(0+0+2) 2	CHEM 341	Heterocyclic .Organic Chemistry	CHEM 241	(0+0+2) 2
CHEM 345	Organic Preparations	CHEM 247 CHEM 241	(4+0+0) 2	CHEM 342	Polymers and .Petrochemicals	CHEM 241	(0+0+2) 2
CHEM 353	Electro-analytical Methods	CHEM 256	(2+0+1) 2	Elective Course From (group B or (C			4
Elective Course From group C			2	University requirement from group A		None	(0+0+2) 2
University requirement From (group A)		None	(0+0+2) 2				
<b>Total</b>			<b>18</b>	<b>Total</b>			<b>17</b>

Seventh Level				Eighth Level			
CHEM 425	Inorganic Reaction Mechanism	CHEM 323	(0+0+2) 2	CHEM 421	Organometallic Chemistry	CHEM 323	(0+0+2) 2
CHEM 430	Electrochemistry	CHEM 335 CHEM 336	(2+0+2) 3	CHEM 429	Practical Inorganic Chemistry	-CHEM 421(Co requisite)	(4+0+0) 2
CHEM 436	Surface Chemistry and Catalysis	CHEM 335	(0+0+2) 2	CHEM 457	Environmental Analysis	CHEM 353	(2+0+1) 2
CHEM 441	Organic Compounds Spectroscopy	CHEM 241	(0+0+2) 2	CHEM 499	Research Project	Finishing 116 h	(6+0+0) 3
CHEM 458	Chromatographic Separation Methods	CHEM 353	(2+0+1) 2	(Elective Course From group B or C			6
CHEM 497	Instrumental Chemical Analysis Training	Finishing h 100	(4+0+0)2	Free Elective Course From group D			3
Elective Course From group B or C			5	<b>Total</b>			<b>18</b>
<b>Total</b>			<b>18</b>				

**Group A: University Requirement: Student chooses 4 courses ( 8 credit hours)**

Course Code	Course Title	Pre- requisite	Credits (Practical – Exercise –Lecture)
IC 100	Studies in the Biography of the Prophet	-	(0+0+2) 2
IC 101	Introduction of Islamic Culture	-	(0+0+2) 2
IC 102	Islam and Building up the Society	-	(0+0+2) 2
IC 103	Economic System in Islam	-	(0+0+2) 2
IC 104	Political system in Islam	-	(0+0+2) 2
IC 105	Human Rights	-	(0+0+2) 2
IC 106	Islamic Jurisprudence	-	(0+0+2) 2
IC 107	Ethics of Occupation	-	(0+0+2) 2
IC 108	Contemporary Issues	-	(0+0+2) 2
IC 109	Woman and Her Developmental Role	-	(0+0+2) 2

**Group B: Elective courses from the college - Student selects 7 credit hours**

Course code	Course Title	Prerequisite	Credit hours
PHYS 102	General Physics )2(	None	(2+0+3) 4
ZOO 103	Principles of General Zoology	None	(2+0+2) 3
BOT 102	General Botany	None	(2+0+2) 3
MBIO 140	Microbiology	None	(2+0+2) 3
GEO 101	Physical Geology	None	(2+0+3) 4
BCH 101	Introduction to Biochemistry	None	(2+0+3) 4

**Group C: Elective courses from the department - *Student selects 10 credit hours***

Course code	Course Title	Prerequisite	Co-requisite	Credit hours
CHEM 310	Computer Applications in Chemistry	None	-	(0+0+2) 2
CHEM 326	Non-aqueous Chemistry	CHEM 323	-	(0+0+1) 1
CHEM 328	Quantum Chemistry )2(	CHEM 320	-	(0+0+2) 2
CHEM 333	Industrial Chemistry	CHEM 232	-	(0+0+2) 2
CHEM 334	Nuclear and Radiation Chemistry	CHEM 201	-	(0+0+2) 2
CHEM 422	Chemistry of Solid State	CHEM 323	-	(2+0+2) 3
CHEM 418	Bio-inorganic Chemistry	CHEM 323	-	(0+0+2) 2
CHEM 419	Industrial-inorganic Chemistry	CHEM 323	-	(2+0+2) 3
CHEM 461	Corrosion	CHEM 430	-	(2+0+1) 2
CHEM 434	Practical of polymer physical chemistry	CHEM 330	-	(4+0+0) 2
CHEM 442	Organic Industries	CHEM 342	-	(2+0+1) 2
CHEM 443	Chemistry of Natural Products	CHEM 341	-	(0+0+2) 2
CHEM 447	Advanced Practical Organic Chemistry	CHEM 345	-	(4+0+0) 2
CHEM 455	Statistical Treatment of Chemical Data	CHEM 353	-	(2+0+1) 2
CHEM 460	Green Chemistry	CHEM 336	CHEM 436	(2+0+2) 3

**Group D- optional requirements from outside the Department (free) (student chooses 3 credit hours)**

Student chooses any course (s) from outside the Department

# Description of BSc. Program Courses:

## **CHEM 101: General Chemistry (1)**

Stoichiometry: SI units, chemical formulae, the mole, methods of expressing concentration, calculations based on chemical equations.

Gases: Laws, kinetic theory, deviation and Van der Waals equation.

Thermochemistry: Types of enthalpy changes, Hess Law and its applications, First Law of Thermodynamics.

Solutions: Type of solutions and laws related, colligative properties.

Chemical Kinetics: Law of reaction rate, reaction order, factors affecting the reaction.

Chemical Equilibrium: Reaction between  $K_c$  &  $K_p$ , Le-Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions

### **Practical General Chemistry**

Eleven experiments dealing with: Physical properties of matter, Hess's law, chemical kinetics, volumetric analysis.

## **CHEM 201: General Chemistry (2)**

Bohr's atomic theory, Electronic structure of atoms, The periodic table, Chemical bonding (Lewis symbols and structures, oxidation numbers, ionic and covalent bonding, resonance, bond enthalpy), Molecular geometry and hybridization of atomic orbitals, Intermolecular interactions, Chemical Kinetics, Chemical equilibrium, Acid-bases equilibria. Practical part: the student performs 10 experiments in the lab concerning the above topics by two hours a week.

## **CHEM 223: Chemistry of Main Groups**

Summary of modern atomic theory, Periodic Table, Periodicity effect, Group I elements: (Li-Cs), Group II elements (Be-Ba), Group III elements: Boron (Al-Tl), Group IV elements: Carbon (Si-Pb), Group V elements: Nitrogen (P-Bi), Group VI elements: Oxygen (S-Po), Group VII elements: (F-At), Group VIII elements: (Noble gases). Ionic bond compounds – Covalent bond compounds - Chemical forces.

## **CHEM 232: Chemical Thermodynamics**

Importance and terminologies, Work and Heat, Zeroth Law, First Law, Thermochemistry, The second and Third Laws, Free energy, partial molar quantities. Chemical potential. Mixing ideal and true solutions, Chemical and physical equilibrium, Statistical thermodynamic.



### **CHEM 240: Organic Chemistry (1)**

Introduction: (Carbon Compounds), Chemical Bonds (ionic, Covalent), Atomic and Molecular orbitals, Hybridization, Polarity and Inductive effect, Alkanes, Cycloalkanes (Alkyl groups, IUPAC nomenclature, Physical properties, Sources off, Synthesis. Reactions (Combustion, Halgenation, Ring opening. Configuration, Cyclohexanes, Alkenes and Alkynes (IUPAC nomenclature, Physical properties, Synthesis (Dehydrohalogenation, from vicinal di-halides, Dehydration of alcohols). Reactions (Acidity of terminal alkynes, Addition reactions (Reduction, Halogenation, Addition of HX – Markovnikov rule, Carbonium ions and their stability, Reaction mechanism), Addition in the presence of peroxides, Hydration, Halohydrin formation), Oxidation of Alkenes ( $\text{KMnO}_4$ , Peroxides and Ozonolysis), Conjugated Dienes (Allyl radical and stability, Allyl cation, 1,3-Butadiene-electron delocalization, Resonance and the Stability of conjugated dienes, 1,4-Addition and 1,4-Cycloaddition reactions of diene), Stereochemistry (Structural isomers and Stereoisomerism, Enantiomers, Diastereomers and Chirality, D and L, The R-S system, Resolution, Molecules with more than one chiral carbon, Reactions of chiral molecules: Inversion, Racemization, Aromatic Compound (Aromatic character, Hukel rule, Nomenclature, Electrophilic substitution reactions (Alkylation, Acylation, Halogenation, Sulphonation, Nitration; reaction mechanism), Side chain halogenation and oxidation, Reactivity and Orientation in substituted benzene, Poly-nuclear aromatics).

### **CHEM 241: Organic Chemistry (2)**

Organic halides (IUPAC nomenclature, Physical properties, Synthesis, Grignard reagents, Nucleophilic substitution  $\text{SN}_1$ ,  $\text{SN}_2$ .  $\text{E}_1$ ,  $\text{E}_2$  mechanism). IUPAC nomenclature, Classification, Physical properties, Synthesis, Reactions of the following organic classes: Alcohols and Thiols; Ethers, Epoxides and Sulfides; Phenols, Aldehydes and Ketones; Carboxylic acids and Their Derivatives, Amines.

### **CHEM 247: Identification of Organic Compounds**

Introduction: (Safety, Laboratory Equipment, Gas cylinders), Solubility, Extraction, Distillation.

Physical constants: melting point, boiling point

Chromatography: Paper (PC), Column (CC), Thin layer Chromatography(TLC)

Functional groups: Alkane, Alkene, Aromatic, Organic halides, Hydroxy-Compounds, Nitro and amine compounds, Aldehydes and Ketones, Carbohydrate, Carboxylic acids and their derivatives. Elemental Analysis.

### **CHEM 252: Fundamentals of Analytical Chemistry**

Concentrations of solutions. Types of equilibrium. Factors affecting equilibrium constant. Precipitation equilibrium and the introduction to quantitative analysis. Acid-base titration. Titration curves. Indicators. Compleximetric titrations. Precipitation titrations. Redox and potentiometric titrations. Gravimetric analysis. Gravimetric calculations.

Practical: Acid-base titrations - Precipitation titrations - Compleximetric titrations - Redox titrations. Some experiments on gravimetric analysis.

### **CHEM 256: Spectroscopic Analytical Methods**

I) Spectrometric methods:

General introduction – the electromagnetic radiation (particle model & wave model) – Absorption of radiation by atoms and molecules – Beers Law (Instrumental dev., chemical dev. And Spectrum. Error) – Instrumentation (source of radiation, mono-chromator, detector, ... etc.) – single-beam spectrometer vs. double-beam spectrometer.

II) Molecular Spectrometric Methods: Molecular Absorption Spectrometry (MAS) – Methods of Analysis and their applications

– Flow Injection Analysis (FIA) – FIA- Spectrometry and some applications – Fluoremetry and Phosphorimetry – FIA - Fluoremetry – FIA-Chemiluminescence.

III) Atomic Spectrometric Methods:

Absorption, emission and fluorescence of radiation by atoms in vapor phase – types of flames, burners and nebulizers – Atomic Emission Spectrometry (AES) – Hollow-cathode lamp – Single-beam vs. double-beam atomic absorption spectrometers – Atomic Fluorescence Spectrometry (AES) – Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) – Arc Spark Emission Spectrography.

Practical section:

Experiments on molecular spectrometry and atomic spectrometry methods.

### **CHEM 310: Computer Applications in Chemistry**

It is a course that aims at enabling students from conducting mathematical calculations using Microsoft Excel. The course will discuss the program's instructions and basic concepts, as well as hands-on training weekly exercises taken from chemistry using Excel software on computers. Through which students learn about the many ways in which Excel can be used as a calculator and an analytical tool for scientific problems and exercises in chemistry.

### **CHEM 323: Chemistry of Transition Elements**

Definition of transition elements. Theories of bonding (Warners Theory, the effective atomic number, the Valence Bond Theory, the Crystal Field Theory, Molecular Orbital Theory, Ligand Field Theory).

Energy levels for the transition metal ions. The magnetic properties of the transition metal complexes. Role of transition metal ions in the biological system. Role of transition metal ions in catalysis.

### **CHEM 320: Quantum Chemistry (1)**

Historical Background: black body radiation, Electromagnetic effect, atomic spectra, Bohr Theory, de Broglie Principle, Heisenberg Uncertainty Principle.

Mathematical review: differentiation, integration, coordinate system, complex numbers, vectors, operators, Eigen functions, odd and even functions, differential equations.

Particle in a box: Interpretation of the wave function, particle in one-dimensional box, normalization of the wave function, orthogonality, energy and wave function of a particle in a box, Correspondence Principle, postulates of quantum mechanics, application of the postulates of quantum mechanics, particle in three-dimensional box, degeneracy.

Simple harmonic motion: view of classical mechanics of the simple harmonic motion, quantum chemistry view of the simple harmonic motion, some mathematical relationships of the simple harmonic motion wavefunction.

Hydrogen atom: solution of the Schrodinger equation of the hydrogen-like atoms, Schrodinger equation and separation of variables, equation of the F function, equation of the T function, equation of the R function, wave function of the hydrogen-like atoms.

Angular Momentum: View of classical mechanics of the angular momentum, commutation and measuring more than property at the same time, commutation and the angular momentum, Eigen values and Eigen functions of the angular momentum, representation of the angular momentum.

### **CHEM 328: Quantum Chemistry (2)**

The Variation Method: Variation Principle, extension of the Variation Method to include the excited states, linear variation functions.

Perturbation Method: Perturbation Method for non-degenerate states, treatment of the Perturbation Method of the helium atom, treatment of the Variation Method of the helium atom.

Electron spin and the Pauli principle: electron spin, Pauli Principle, the helium atom, the lithium atom, Slater determinant.

Angular momentum of multi-electron atoms: Hamiltonian Operator of multi-electron atoms, the total electronic angular momentum, the angular momentum of multi-electron atoms, state symbol, equivalent and non-equivalent electrons, fine structure of the electronic spectrum of the hydrogen atom, electronic spectrum of the helium atom.

Huckel Molecular Orbital Method: Huckel Molecular Orbital Method, application of the Huckel Molecular Orbital Method to hydrocarbons with conjugate double bonds, delocalization energy, charge density and bond order.

### **CHEM 329: Inorganic Compounds Spectroscopy**

Introduction: characterization of electromagnetic radiation, quantization of energy, regions of spectrum, representation of spectrum, basic elements of practical spectroscopy, signal-to-noise, resolving power, width and intensity of spectral lines.

Microwave spectroscopy: rotation of molecules, rotational spectra, diatomic molecules.

Infra-red spectroscopy: vibrating diatomic molecule, diatomic vibrating rotator, vibration-rotation spectrum of carbon monoxide, breakdown of the Born-Oppenheimer approximation, interaction of rotations and vibrations.

Electronic spectroscopy of atoms: structure of atoms, electronic angular momentum, multi-electron atoms, angular momentum of multi-electron atoms.

Spin resonance spectroscopy: spin and applied field, nuclear magnetic spectroscopy, electron magnetic spectroscopy.

Group Theory: Molecular symmetry and the symmetry groups, symmetry point groups, representation of groups, applications.

### **CHEM 330: Physical Chemistry of Polymers:**

Introduction, Definitions, classification of polymers, Polymerization and copolymerization techniques, Characterization and determination of molecular weight, Configuration of polymers chains (structure and microstructure), Solubility of polymer and miscibility, Determination of thermal properties of polymers.

Practical:

- Solubility and precipitation of polymers
- Techniques of purification of monomers, catalysts and polymers
- Polymerization of suitable monomer using free radical
- Polymerization of suitable monomer using anionic or cationic polymerization
- Polymerization of suitable monomers using poly condensation method
- Copolymerization using free radicals and characterizations
- Determination of molecular weight by viscosimetry
- Grafting of polymer using free radical.
- Determination of structure and microstructure of polymer using spectroscopic techniques

**CHEM 333: Industrial Chemistry**

Physical Processes in Chemical Industry, Mass and Energy Balance in Industrial Processes, Industrial Thermo-chemistry, Chemical Conversion Processing, Main Catalysts used in Chemical Industry, Industrial Applications of Electrochemical Cells and Electrolysis, Corrosion Phenomenon and its industrial solutions.

**CHEM 334: Nuclear and Radiation Chemistry**

Part One: Nuclear chemistry, Introduction, atomic nuclei, radioactive decay process, nuclear reaction, equations of radioactive decay and growth, interaction of radiation with matter, radiation detection and measurement, techniques in nuclear chemistry, radiochemical applications and beneficial uses of isotopes, sources of nuclear bombarding particles, reactor safety and radiation protection and control.

Part Two: Radiation chemistry, reaction dosimetry, radiolysis of water and aqueous solution, radiolysis of organic systems, radiolysis of gases, applications of radiation chemistry.

**CHEM 335: Chemical Kinetics**

Reaction rate, concentration and time, rate expression, reaction order, half time, rate-concentration plot, experimental methods, kinetics of simple reactions with different orders, determination of rate and orders, reaction rate and temperature, Arrhenius equation, Activation energy calculation, Complex reaction and mechanism. Introduction to catalysis, solid-gas and solid-liquid heterogeneous catalysis, chemical kinetics of heterogeneous catalysis, types and preparation of catalysts, major industrial reactions

**CHEM 336: Physical Chemistry of Solutions**

Some notions on the liquid properties;

The simple mixtures (the thermodynamic description of mixtures, the Partial molar quantities); The Chemical potential of liquids (ideal solutions, ideal-dilute solutions); Ideal and non-ideal solutions of non-electrolyte; Colligative properties (the common features of colligative properties, the elevation of boiling point, the depression of freezing point, the solubility, the osmosis); Activities of solvent and solute (ideal-dilute solutions, real solutes, activities in terms of molalities, the biological standard state); Activities coefficient (the activities of regular solutions, mean activity coefficients); Ionic solutions (the thermodynamic properties of ions in solution, the Born and Debye-Huckel models, solubility and dissociation, electrolytic conductance, ionic mobility, transport number); Phases diagrams of binary systems (vapor pressure diagrams, liquid- vapor phase diagrams, liquid-liquid phase diagrams, solid-liquid phase diagrams).

### **CHEM 341: Heterocyclic Organic Chemistry**

Heterocycles, Nomenclature, Aromaticity, Five-membered heterocycles: Pyrroles, Indoles, Diazoles, Synthesis, Reactions, Cycloaddition Reactions, Six-membered heterocycles, Pyridine, quinoline, Basicity, Synthesis, Reactions. Heterocyclic compounds versus microbes, Antibiotics, antitumors and Dyes. Biologically important Heterocycles, Uracils and Purins. Carbohydrates, Definition, Nomenclature, Classification, Monosaccharides: absolute configuration, cyclic structures, oxidation, reduction, osazones, ascorbic acid, amino sugars. Oligosaccharides and Polysaccharides, Cellulose technology. Amino acids, Proteins, Natural amino acids: Properties, Synthesis and Reactions, Synthesis of Peptides, Protein classification. Lipids, Classification, Waxes, Oils and Fats (Glycerides), synthesis and properties of Glycerides, Glycolipids.

### **CHEM 342: Polymers and Petrochemicals**

Classification of polymers, Chemical and Physical properties, General methods for polymer synthesis, Condensation and Addition polymerization, Copolymerization, Polymer technology and application, Degradation and Stabilization of polymers. Petrochemicals from natural gas, Benzene, Toluene and Xylene.

### **CHEM 344: Organic Reaction Mechanism**

Introduction, Thermodynamic and Activation energy. Physical and Chemical Methods to identify a Reaction Mechanism, reaction kinetics, Isotope labeling, intermediate determination, stereochemistry, crossover experiments. Reactions: Acids and Bases, Nucleophilic Substitution, Elimination Reactions, Electrophilic Addition to a double bond, Nucleophilic Addition to a carbonyl group, Rearrangements and free radicals.

### **CHEM 345: Organic Preparations**

Introduction, Safety, Lab. Equipment, Spectroscopy, IR Identification of Unknown, Preparation of derivatives, Reports  
Unknowns 1 – 5 Identification of Mixture components and separation.

### **CHEM 353: Methods of Electrical Analysis:**

Electrochemical cell. Cell potential and Nernst Equation. Calculation of the cell potential. Types of electrodes- reference electrodes and working electrodes. Junction potential. Potentiometry and potentiometric methods. Ion selective electrodes. Electrogravimetric methods. Coulometric methods. Voltammetric methods of analysis. Polarography and stripping voltammetry.  
Practical section: Selected experiments covering different electro analytical techniques.

### **CHEM 421: Organometallic Chemistry**

Introduction (definition, classification and stability of organometallic compounds), classification, bonding and synthesis of main group organometallic compounds, organo-transition metal complexes, classification of ligands, EAN rule and its applications, nature of bonding in transition metal complexes, d and p-complexes, metal-carbon bond cleavage reactions, oxidative-addition reactions, applications in homogeneous and heterogeneous catalysis.

### **CHEM 422: Chemistry of Solid state**

Types of solids, external structure of solids, introduction to point group symmetry, internal structure of solids, crystal systems and unit cell, lattice types, lattice plans and directions, basic crystallographic calculations, X-ray diffraction, crystal structure of elements and inorganic compounds, defects in solid, inorganic industries (Steel, cement, glass).

#### **Experiments:**

Study of crystal structure using computer programs: Metals and alloys, Inorganic compounds, Molecular compounds.

- Thermal analysis and its applications.
- X-ray diffraction and its applications
- Applications of SEM and TEM
- Identification of solid materials:

Manuals method, Computer programs method.

- Nano-synthesis and studies of :

Alloy - MgO and Mg(OH)<sub>2</sub> - Perovskite SrTiO<sub>3</sub> - BaTiO<sub>3</sub> - Spinel MgAl<sub>2</sub>O<sub>4</sub> - Glass

### **CHEM 425: Inorganic Reaction Mechanism**

Introduction to inorganic reaction mechanisms, soft and hard acids and bases, Nucleophilic substitution reactions at four-coordinate Site, Mechanism of Oxidation-Reduction reactions, Bio-inorganic Chemistry including: Non red-ox metallic enzymes, Oxygen carriers and the weight of oxygen proteins, Proteins of the hemoglobin, Nitrogen fixation and sulfur, iron proteins, Heavy metal ion storage, Metals and non-metals in medicine and biological system.

### **CHEM 426: Bio – inorganic Chemistry**

The alkali metals and alkaline earth cations in biosystems.

- 1) Non-redox metalloenzymes.
- 2) Oxygen carriers and oxygen transport proteins, electron transfer and photosynthesis.



- 3) Hem proteins and copper proteins in redox reactions, vitamin B12.
- 4) Nitrogen fixation and iron-molybdenum-sulphur proteins.
- 5) Metal ion transport and storage.
- 6) Metals and non-metals in biology and medicine
- 7) Physical measurements.

### **CHEM 427: Industrial – inorganic Chemistry**

#### 1 - Water

- a- Water quality.
- b- Fresh water treatment.
- c- Waste water treatment.
- d- Desalination of sea water.
- e- Water pollution.

#### 2 - Metallurgy

- a- Ore dressing: sorting, magnetic separation, floatation.
- b- Pyrometallurgy: extraction of iron, lead, chromium, tin, antimony, etc.
- c- Hydrometallurgy: extraction of gold, silver, mercury, etc.
- d- Electrometallurgy: extraction of aluminum and sodium.
- e- Thermite: extraction of vanadium and chromium.

3 - Ultra purification of metals. Electro refining, zone refining, chemicals refining, alloys.

4 - Ceramics: composites. Processing of ceramics, applications of ceramics, superconducting ceramics.

5 - Glass and quartz industry  $B_2O_3$  glass (Pyrex and kimax glass)

6 - Cement industry

7 - Extraction of elements for semiconductors Ultrapure silicon, gallium, phosphorous, arsenic.

8 - Extraction of radioactive elements Ion exchange process, solvent extraction.

9 - Sulfuric acid, Nitric acid, Hydrochloric acid industries.

10- Inorganic fertilizers, Detergent and household cleaning stuff.

Practical: Visits to industrial sites.

### **CHEM 429: Practical Inorganic Chemistry (2)**

The electromagnetic radiation – preparation of samples for I.R. measurements – Preparation of some organometallic compounds and measuring their spectra – titration for non-aqueous solutions – study of the spectra of complexes – study of the kinetics of isomeric transformation of inorganic compounds - study of the electronic structure and electronic spectra - study of U.V. spectra of some compounds and evaluating the absorption coefficient and concentration.

**CHEM 430: Electrochemistry**

Solid-liquid interfaces, electrochemical potential, electrochemical reactions and Nernst equation, liquid junction potential, electrode kinetics, rate of electrochemical reactions, Butler-Volmer equation, Tafel equation, diffusion and electrochemical reactions, cyclic voltammetry and mechanism of electrochemical reactions.

Practical:

Measurement of electrochemical cell- Application of Nernst Equation- Determination of mean activity coefficient by electrochemical method- Determination of  $K_{sp}$  of a sparingly soluble salt by electrochemical method- Determination of thermodynamic functions by electrochemical method- Difference between galvanic and electrolytic cell- Precipitation of metals as a protection from corrosion- Application of Tafel Equation- Application of Cyclic voltammogram in an electrochemical cell.

**CHEM 432: Corrosion**

Essential definitions and terminologies. Direct and indirect costs of corrosion. Classifications of corrosion (types of corrosion). Methods of corrosion rate measurements. Thermodynamics and kinetics of corrosion. Factors affecting corrosion. Methods of corrosion control.

Practical: A number of experiments on Corrosion.

**CHEM 436: Surface Chemistry and Catalysis**

Surface and interfaces: Types of interfaces, Surface free energy, Surface tension.

Solid-Gas interface: Physical adsorption, chemical adsorption, adsorption measurement methods, adsorption isotherms, adsorption applications.

Homogeneous Catalysis: Acid & base catalysis, oxidation-reduction catalysis, chain reaction catalysis, coordination catalysis.

Heterogeneous Catalysis: Solid-Gas heterogeneous catalysis, Solid-Liquid heterogeneous catalysis, main types of catalysts, preparations of heterogeneous catalysis, catalyst characterization.

**CHEM 441: Organic Compounds Spectroscopy**

Introduction, Structural elucidation by Spectroscopic Methods; Ultraviolet (UV) and Visible, Infrared (IR),  $^1\text{H}$  and  $^{13}\text{C}$  Nuclear Magnetic Resonance and Mass Spectrometry; Applications of these spectroscopic tools.

### **CHEM 442: Organic Industries**

Production and uses of Petroleum and basic Petrochemicals and Inorganic chemicals, Downstream industries, Pioneers in the field of Chemical and Downstream industries in the Kingdom of Saudi Arabia.

Practical: Experiments include Preparation and Characterization of selected petrochemicals and non-petrochemicals.

### **CHEM 445: Chemistry of Natural Products**

Introduction, Secondary metabolites, isolation, separation and structural identification. Isoprenoids: Terpenes, classification, monoterpenes and sesquiterpenes. Steroids: Triterpenoids and Sterols, Cardiolides, Biosynthesis of Terpenoids and Steroids (Acetate Pathway). Alkaloids, Classification, Examples: Pyrrolidines, Piperidines, Isoquinolines, Quinolines, Indoles and Purines. Biosynthesis of Alkaloids (Amino acid Pathway). Alkaloids, Examples: Flavonoids, Anthraquinones, Coumarins, Xanthenes, and Polyketide pathway.

### **CHEM 447: Advanced Practical Organic Chemistry**

Introduction, Safety, Lab. Equipments

Preparation and study of some organic compound, spectroscopy, yield and its percentage

Examples of such Preparations and Reactions:

- Diels Alder Reaction - Oxidation of side chain - Reaction of  $S_N^1$   $K S_N^2$ ,  $E^1$ -Nitration of Organic compounds.
- Reduction of Nitrocompounds - Grignard Reaction - Perkin condensation - Friedel-Crafts alkylation - Alder Condensation, -Esterification - Polymerization - Polystyrene - Baekalite.

Isolation and Identification of Natural Products, using TLC and CC in purification of organic compounds.

### **CHEM 455: Statistical Treatment of Chemical Data**

Errors in chemical analysis. Statistical evaluation of analytical data. Expressions of analytical results. Clinical chemistry. Application of analytical chemistry in industry.

Practical: Selected experiments on applied instrumental analysis.

### **CHEM 457: Environmental Analysis**

Atmospheric composition, gaseous pollutants, water pollution, gaseous pollutants control, water pollutants, soil pollutants, medical pollutants, waste treatment and recycling.

Practical section:

Determination of metal (Mg, Cr, K, P, N ....) in plant sample, Hg in urine samples, Pb and Cd in paints...etc.

### **CHEM 458: Chromatographic Separation Methods**

Principles and applications of solvent extraction. Ion exchange chromatography. Paper chromatography. Thin layer chromatography. Column chromatography.

Liquid chromatography. High performance liquid chromatography. Gas liquid chromatography.

Practical: Selected experiments on paper chromatography. Ion exchange chromatography. Column chromatography. High performance liquid chromatography and gas liquid chromatography.

### **CHEM 460: Green Chemistry**

This course focuses on the study of Principles of Green Chemistry (pollution prevention, atom economy, less hazardous chemical synthesis, designing safer chemicals, safer solvents and auxiliaries, design for energy efficiency, use of renewable feedstock, reduce derivatives, catalysis, design for degradation, real-time analysis for pollution prevention, and inherently safer chemistry for accident prevention) Practical Part: 2 hours per week

-Compare a chlorinated cleaning product to a similar “green” product which uses no chlorine.

-Phosphates versus non-phosphate cleaning products.

**CHEM 497: Instrumental Chemical Analysis Training**

Student gain the ability to operate the scientific instruments common in use and knowing their components. Practical training on instrumental chemical analysis techniques: Spectroscopic techniques, separation techniques, thermal analysis, electrochemical techniques, sorption techniques. Student uses the instruments and knows how to analyze the different chemical samples.

**CHEM 499: Research Project**

The student undertakes a research project on a specific topic and submits a report at the end of the semester to be subjected to the departmental procedures and evaluated by a committee according to formal defined criteria.





# M.Sc. Program in Chemistry

## Program Goals:

1. To enrich the chemistry experiences of students by offering advanced courses covering the new trends in chemistry.
2. To engage students in a cutting-edge research projects leading to innovation and high quality publications.
3. To prepare effective graduates for serving the society in the field of chemistry.

## Admission Requirements:

- Admission and registration procedures must follow the regulations of the Higher Graduate Deanship of King Saud University.
- Supplementary courses, deemed necessary by the Department Council, for any graduate from a chemistry department in any institute other than King Saud University. The student should pass the exams with grade “good” at least in each course, and at least with grade “very good” in all courses (cumulative).
- The student should have attained in his undergraduate studies at least a grade of “very good” and it may be possible to admit a student with a grade of “good<sup>+</sup>” in accordance with Article 15 of the Higher Studies Statutes at King Saud University.
- The admission is for full-time registration. However, part - time study may be permitted during the period of studying the courses and before the registration of the dissertation.

## Academic Requirements:

**Courses:** The required credit hours for the Master’s degree are 24 hours of graduate level courses in chemistry spread over three academic semesters where eight credits are studied in each semester. The 8 credits consist of 2 credits in each of the following specializations: Analytical, Inorganic, Organic and Physical Chemistry.

The student must obtain in each course at least “good”, and a cumulative of “very good” in two successive semesters.

**Dissertation:** The student must submit a dissertation showing originality and innovation.

**Study period:** The minimum period necessary to complete the Program is 4 academic semesters (two years), while the maximum is 8 semesters.



# Study Plan:

## 1<sup>st</sup> Level

Courses	Course Title	Credit Hours
CHEM 524	Advanced organometallic Chemistry	2+0
CHEM 530	Advanced Chemical Kinetics	2+0
CHEM 540	Stereochemistry	2+0
CHEM 550	Spectrometric Methods of Analysis & Automation	2+0
Total	8 (units)	

## 2<sup>nd</sup> Level

Courses	Course Title	Credit Hours
CHEM 520	Quantum Chemistry and its Applications	2+0
CHEM 531	Advanced Chemical Thermodynamics	2+0
CHEM 541	Organic Spectroscopy	2+0
CHEM 551	Separation Methods	2+0
Total	8 (units)	

## 3<sup>rd</sup> Level

Courses	Course Title	Credit Hours
CHEM 523	Physical Methods in Inorganic chemistry	2+0
CHEM 532	Advanced Physical Chemistry	2+0
CHEM 542	Special Topics in Organic Chemistry	2+0
CHEM 552	Electro-Chemical Methods of Analysis	2+0
Total	8 (units)	

## 4<sup>th</sup> Level

Courses	Course Title	Credit Hours
CHEM 600	Dissertation (M.Sc. Thesis)	6
Total	6 (units)	

# Courses Description:

## **CHEM 520: Quantum Chemistry and its Application 2(2+0):**

Wave mechanics of the rigid diatomic rotor, wave mechanics of the simple harmonic oscillator, calculations of rotational vibration transition for diatomic molecules. Correction to the rigid rotor-harmonic oscillator model. Perturbation theory for solving Schrodinger equation. Group theory and quantum mechanics. Symmetry adapted linear combination. Symmetry and MO theory. Molecular vibration, IR and Raman Spectroscopy.

## **CHEM 523: Physical Methods in Inorganic Chemistry 2(2+0):**

Magnetism, electronic spectroscopy, magnetic resonance(NMR), electronic paramagnetic resonance (E.P.R) nuclear quadropole resonance (N.Q.R), Mössbauer spectroscopy, mass spectroscopy and x- ray single crystal analysis.

## **CHEM 524: Advanced Organometallic Chemistry 2(2+0):**

A study of the Chemistry and Physical properties of compounds of the transition metals, clusters and carbenes, insertion reaction, oxidative addition, reductive elimination, homogeneous catalysis, bonded organometallic compounds, spectral and magnetic properties of compounds.

## **CHEM 530: Advanced Chemical Kinetics 2(2+0):**

Kinetics of chain reaction in gaseous phase (linear, branched and explosions reaction). Kinetics of reaction in solution (homogenous catalysis, enzyme reaction, and reaction mechanism in solution). Heterogeneous reaction (gas-solid adsorption, kinetics of reaction, application of transition state theory of surface reaction, and heterogeneous catalysis).

**CHEM 531: Advanced Chemical Thermodynamics 2(2+0):**

Revision to thermodynamics, macroscopic and microscopic state, application of statistical mechanics to thermodynamics functions, some statistical calculations.

**CHEM 532: Advanced Physical Chemistry 2(2+0):**

Physical Chemistry of Polymers, surface Chemistry, nuclear and radiations chemistry, photo-chemistry and laser, corrosion science, catalysis.

**CHEM 540: Stereochemistry 2(2+0):**

Static stereochemistry, Isomerism, symmetry, models, optical activity and optical stereoisomerism, chirality and the sequence rules, cyclic alkanes and stereochemistry. Dynamics stereochemistry: addition reaction, elimination reaction, substitution reactions, rearrangements, cyclic reaction. Identification of organic compounds including some illustrative examples of the use of these techniques in multi-step synthesis.

**CHEM 541: Organic Spectroscopy 2(2+0):**

Applications of Spectroscopy: IR, NMR, MS, UV in the identification of organic compounds. Various examples of organic multi - steps preparations and the use of spectroscopy for the identification of its products.

**CHEM 542: Special Topic in Organic Chemistry 2(2+0):**

Comprehensive study of some selected topics in organic chemistry.

**CHEM 550: Spectrometric Methods of Analysis & Automation 2(2+0):**

Atomic spectroscopy (atomic emission, atomic absorption, atomic fluorescence) and molecular spectroscopy (molecular emission and absorption in the UV-VIS region).

**CHEM 551: Separation Methods 2(1+1):**

Chromatographic Methods, Theory, instrumentation and application.

**CHEM 552: Electrochemical methods of Analysis 2(2+0):**

Voltammetry, amperometric titration, coulometry, electrogravimetry, potentiometry, conductimetric titration and statistical analysis.

**CHEM 560: Chemistry and Life 2(2+0):**

An introduction to the role of inorganic chemistry in bio – systems. Environmental pollution especially air pollution. Peaceful applications of nuclear energy particularly in medical fields. Radioactive pollution, damage and methods of protection.

**CHEM 600: MSc.Thesis**





M.Sc. Program in Polymers  
(male students only)

# Master of Science in Polymer Science

Polymers are generally produced by chemical conversion of Primary or Intermediate petrochemicals by a processes called polymerization, it is used in the production of plastics, fibers and synthetic rubber, Degree name: Master of Science in Polymers. Science

## Program Objectives:

- 1- This program aims at enriching the scientific researches in the field of polymer, Since polymers constitute the major percentage of the petrochemical production in the kingdom.
- 2- Reinforcing the cooperation between the university, the private sectors and the corresponding governmental institutions.
- 3- Preparing the student to contribute in achieving the requirements of the industrial developments and the involvement in the labor market.

## Admission Requirements:

- 1) BSc. in Chemistry.
- 2) It is possible to accept students from other departments as long as they fulfill the admission requirements of the unified law organizing the graduate studies in the Saudi Universities.
- 3) The students should pass the admission test and the interview held by the chemistry department.

## Degree requirements:

- A- The MSc programs are based on courses and thesis. The courses are divided on three semesters. Each semester has four courses. The students must attended and pass successfully the exams of these courses.
- B- Preparing a thesis in the polymer science.

## Program Structure:

Twenty-four Credit hours and a Thesis are required.

### 1<sup>st</sup> Semester

Course No.	Course Title	Credit Hours
CHEM 561	Fundamental of Polymer Science	2+0
CHEM 562	Material Science	2+0
CHEM 563	Biopolymers	2+0
CHEM 564	Synthesis of Polymers	2+0
Total		8

### 2<sup>nd</sup> Semester

Course No.	Course Title	Credit Hours
CHEM 571	Polymer Degradation and Stabilization	2+0
CHEM 572	Characterization of Polymeric Materials	2+0
CHEM 573	Selected Topics	2+0
CHEM 574	Preparation and Characterization of Polymer	0+2
Total		8

### 3<sup>rd</sup> Semester

Course No.	Course Title	Credit Hours
CHEM 581	Polymer Solutions	2+0
CHEM 582	Polymer Transitions	1+0
CHEM 583	Polymer Processing	2+1
CHEM 584	Seminar	2+0
Total		8

### 4<sup>th</sup> Semester

.Course No	Course Title	Credit Hours
CHEM 600	Thesis	6
Total		6



# Courses Description

## First Semester

### **CHEM 561: Fundamental of Polymer Science 2(2+0)**

Basic concepts of polymers, methods of classification and mechanisms of polymerization, Introduction to state of phases, Basic concept of phase transformation. Specific features of the ordered-state, practical importance of the theory of phase and phase change. Introduction to true polymer solution and interaction in polymer solution.

### **CHEM 562: Material Science 2(2+0)**

Behavior of materials and this includes relationship between structures and properties of polymeric materials, ceramic, the link between the fine structure of materials and their physical and mechanical properties.

### **CHEM 563: Biopolymers 2(2+0)**

Biopolymers of industrial importance. Methods of their synthesis, modifications, and degradations, Physical and chemical properties. Applications of Biopolymers in industry and their contribution in improving the environment.

### **CHEM 564: Synthesis of Polymers 2(2+0)**

Different methods of polymers synthesis, polymerization techniques and technical factors affecting them, copolymers synthesis, methods of controlling structure and composition of copolymers, special emphasis on catalysts and their methods of preparation, their role and their important industrial applications in the field of polymers, reactions of polymer function groups.

## Second Semester

### **CHEM 571: Polymer Degradation and Stabilization 2(2+0)**

Physical and chemical parameters which affect the stability of polymers, mechanisms of polymer degradation, chemical and physical methods used to improve the stability of polymers against different parameters, and in particular environmental and aging parameters.

### **CHEM 572: Characterization of Polymeric Materials 2(2+0)**

Techniques used for physical and chemical characterization of polymeric materials. gthermal analysis and spectroscopic techniques. Methods of molecular weight determination.

**CHEM 573: Selective Courses 2(2+0)**

Rheology of polymers and other subjects in the field of polymer.

**CHEM 574: Preparation and Characterization of Polymer 2(0+2)**

Preparation of some polymers, training on the methods of polymer characterizations.

## Third Semester

**CHEM 581: Polymer Solutions 2(2+0)**

Study of polymer solutions, their thermodynamics properties e.g. vapors pressure, osmotic pressure, swelling pressure, thermodynamics parameters of solubility, entropy of mixing and internal energy. The thermodynamic of high elastic and glassy polymer solutions. Thermodynamics of copolymer solution with emphasis on the various applications.

**CHEM 582: Polymer transitions 1(1+0)**

Mechanisms of crystallizations and factors affecting them. Glass transition and its relationship with the chemical structure of polymers. Methods used for the determination of the glass transition of polymers, practical importance of the thermomechanical methods.

**CHEM 583: Polymer Processing 3(2+1)**

Rheological and mechanical properties, different methods used in polymer processing e.g. extrusion blowing, reforming. The effect of processing parameters on the properties of the final products. Standard methods used for testing the properties of the final products e.g. ASTM and others. Experiments on polymers processing and measuring some of the mechanical properties of polymers. Arranging of some visits to production and processing facilities in the industrial zones.

**CHEM 584: Seminar 2(2+0)**

Various applications of polymers in different fields, particularly the recent applications e.g. electronics materials, smart material, biomedical applications, agricultural applications, optic fibers, biosensors, membranes, etc.

## Fourth Semester

**CHEM 600: Supervision**

The supervision will be determined based on the subject of the thesis. In case of being the principal supervisor from outside the department, the assistant supervisor must be from the chemistry department and should be specialized in polymer science.





# Ph.D. Program in Chemistry

# PhD. Program in Chemistry

## Program Goals:

- 1- To prepare graduates with systematic understanding, new knowledge, critical awareness, and skills in the field of chemical sciences.
- 2- To prepare a new generation of scientists for developing and addressing the scientific problems in academia and industry.
- 3- To provide learning opportunities to enable beneficiaries to think critically and continue to develop themselves as an autonomous lifelong learner.

## Admission Requirements

- i. Personal meeting.
- ii. Admission of full-time students.
- iii. TOEFL: should be passed at least with a rate of 450.

## Admission Requirements:

- 4- The candidate should hold a Master's Degree from King Saud University or an equivalent degree.
- 5- The candidate must pass a personal interview arranged by the Department.
- 6- Admission is for full - time registration. However, part - time study may be permitted during the period of studying the courses and before the registration of the dissertation.
- 7- The candidate must have obtained at least a score of 450 in the Test of English as a Foreign Language (TOEFL).

## Academic Requirements:

**Courses:** The courses constitute 18 credits (9 Credits are common to all the Programs students where the others depend on the Track and should be from a particular specialization). The courses should be completed within two academic semesters.

**A Comprehensive exam:** Three papers, two are in all branches of chemistry, while the third one is in the branch which would be selected by the student as the subject for his/ her thesis. The duration of each paper is three hours. The second part of this exam is oral and requires 2- 3 hours covering all branches of chemistry. The student should pass this exam in the first time. However, in the case of failing (even in part of the exam), another chance is given to the student to attend the exam within the two following semesters. If the student fails for the second time, his registration will be cancelled.

**Thesis:** It cannot be registered unless the student passes the comprehensive exam.

**Study Plan:** The Program is composed of four Tracks as follows: Analytical, Inorganic, Organic and Physical Chemistry.

**Study period:** The minimum period for the Program is 6 academic semesters (two years) while the maximum is 10 semesters.

# Study Plans:

## 1<sup>st</sup> Semester (For All Students)

Course No.	Course Title	Credit Hours
CHEM 620	Advanced Inorganic Chemistry	2+0
CHEM 630	Applied Physical Chemistry	2+0
CHEM 640	Advanced Organic Chemistry	2+0
CHEM 650	Different Topics in Analytical Chemistry	2+0
CHEM 660	Seminar	1+0
Total	9 (units)	

## 2<sup>nd</sup> Semester (Track Selection)

### 1) Inorganic Chemistry

Course No.	Course Title	Credit Hours
CHEM 621	Inorganic Chemistry. Theory & Application	3+0
CHEM 622	Structural Elucidation by Physical Methods	3+0
CHEM 623	Selected Topics in Inorganic Chemistry	3+0
Total	9 (units)	

### 2) Physical Chemistry

Course No.	Course Title	Credit Hours
CHEM 631	Chemical Physics	3+0
CHEM 632	Physical Methods in Material Analysis	3+0
CHEM 633	Selected Topics in Physical chemistry	3+0
Total	9 (units)	

### 3) Organic Chemistry

Course No.	Course Title	Credit Hours
CHEM 641	Advanced Natural Products	3+0
CHEM 642	Physical Organic Chemistry	3+0
CHEM 643	Selected Topics in Organic chemistry	3+0
Total	9 (units)	

### 4) Analytical Chemistry

Course No.	Course Title	Credit Hours
CHEM 651	Advanced Studies in Instrumental Analysis	3+0
CHEM 652	Applied Analytical Chemistry	3+0
CHEM 653	Selected Topics in Analytical chemistry	3+0
Total	9 (units)	

## 3<sup>rd</sup> Semester (For All Students)

Course No.	Course Title	Credit Hours
CHEM 700	Dissertation	12
Total	12 (units)	



# Description of PhD. Courses

## **CHEM 620: Advanced Inorganic Chemistry 2(2+0)**

Metal-metal single and multiple bonds. Transition metals hybrids, electron deficient compounds, lanthanides and actinides.

## **CHEM 621: Inorganic Chemistry; Theory & Application 3(3+0)**

Spectroscopic applications of quantum chemistry and group theory, theoretical aspects of solid state chemistry and application in semi- and super-conductors and chemical industries.

## **CHEM 622: Structural Elucidation by Instrumental methods 3(3 + 0)**

Single crystal x-ray diffraction, I.R. and Raman Spectroscopy, NMR spectroscopy, Magnetic susceptibility, ESR and Mössbauer spectroscopy.

## **CHEM 623: Selected Topics in Inorganic Chemistry 3(3 + 0)**

- a) Bioinorganic chemistry
- b) Recent advances in organometallic chemistry
- c) Kinetics and mechanisms of inorganic reactions.

**CHEM 630: Applied Physical Chemistry 2(2 + 0)**

Thermodynamics, chemical kinetics, nuclear and radiation chemistry, chromatography, photochemistry, chemistry of surface and colloids.

**CHEM 631: Chemical Physics 3(3 + 0)**

basic techniques being used to solve many chemical Problems which includes: Spectroscopy, mass spectroscopy, molecular beams, statistical mechanics...etc.

**CHEM 632: Physical Methods in Material Analysis 3(3 + 0)**

Methods of Physical analysis of materials and its interpretations, e.g. thermal analysis, particulate characterization, X-ray, electronic microscopes...etc.

**CHEM 633: Selected Topics in Physical Chemistry 3(3 + 0)**

Students are required to achieve a comprehensive study about the subject expected to specialize in among physical chemistry branches, e.g. Physical chemistry of polymers, laser, electrochemistry, etc.

**CHEM 640: Advanced Organic Synthesis 2(2 + 0)**

Oxidation-reduction reactions. Application of modern synthetic reactions in C-C bond and multi-step organic synthesis.

**CHEM 642: Advanced Natural Products 3(3 + 0)**

Advanced studies in the preparation and separation of natural products.

**CHEM 642: Physical Organic Chemistry 3(3 + 0)**

Stereochemistry, linear Gibbs energy relation, thermochemistry, solutions, kinetics and mechanism, interpretation of rate constant, application of the per cyclic selection rule, photochemistry

**CHEM 643: Selected Topics in Organic Chemistry 3(3 + 0)**

A comprehensive study of a specialized subject among organic chemistry; i.e. industrial organic chemistry technology, multi-nuclear NMR, ...etc.

**CHEM 650: Various Topics in Analytical Chemistry 2(2 + 0)**

Advanced studies in chemical equilibria, new chemical (non-instrumental) methods of analysis, statistical evaluation of analytical data.

**CHEM 651: Advanced Studies in Instrumental Analysis 3(3 + 0)**

Studies in the new concepts of various instrumental methods of analysis such as electro analytical, spectrophotometric and chromatographic methods of analysis.

**CHEM 652: Applied Analytical Chemistry 3(3 + 0)**

The use of computer in analytical chemistry, various studies in the general applications of analytical chemistry.

**CHEM 653: Selected Topics in Analytical Chemistry 3(3 + 0)**

A comprehensive study of specialized subject among analytical chemistry. i.e. electroanalysis, spectrophotometric analysis, chromatography, etc.

**CHEM 660: Seminar 1 (1 + 0)**

A literature review of one of the topics suggested by the staff members. The student should present a talk on the topic after reviewing the literature and preparing a written article. The staff member would then evaluate the student accordingly.

**CHEM 700: Dissertation**

# Research Facilities Available in the Department

Most of the research laboratories are well equipped to carry out most modern research in the faculty members' areas of interest. These equipment include:

NMR 400 MHz, FT-IR, GC/MS, CHN analyzer, X-ray diffractometers (for single crystal and powder form), ICP, HPLCs, AAS, TGA/DSC etc.

## Research Groups:

There are several research groups working in different areas of chemistry such as:

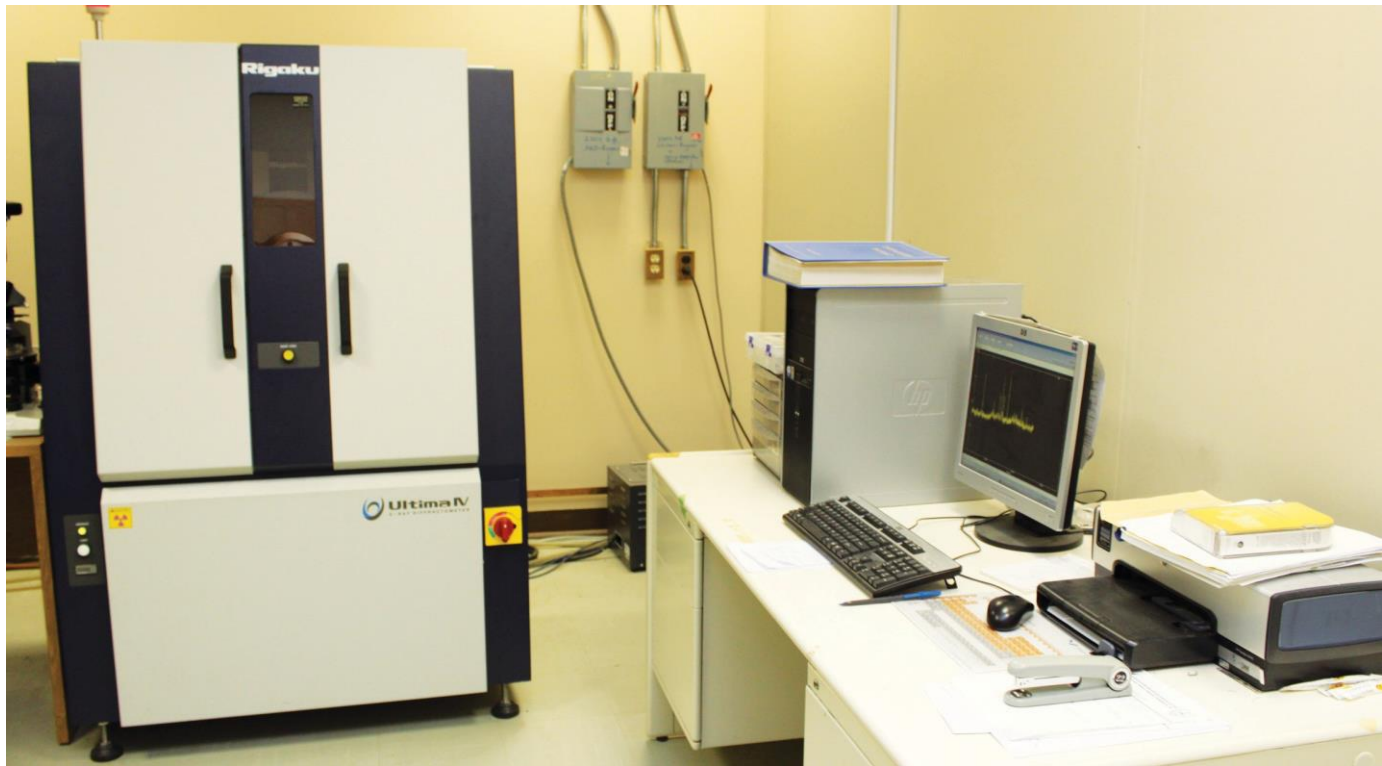
- Synthesis, characterization and applications of nano particles.
- Catalysis.
- Natural products.
- Petrochemical.
- Chromatography.
- Polymer research.
- Radiopharmaceutical preparation and characterization of New Re, Tc, Ga and Sm complexes of potential use as radiopharmaceutical.
- Ceramic materials preparation of ceramic materials at nano scale for industrial and medical application.
- Inorganic-organic Hybrid Ru(II) complexes and their application in selective hydrogenation and catalyst recycling.
- Solid State X-ray analysis of novel organometallic complexes.



UPLC



GC



Crystal x-ray



Powder x-ray



NMR



HPLC



# Saudi Chemical Society (SCS)

The Chemistry Department has hosted the Saudi Chemical Society since its inception in 1989. The Chairman of the Board of Directors is a faculty member **Prof. Zeid A. Al-Othman**

The Society publishes two scientific journals which are edited by two of the Department's faculty members as follows:

1. Journal of Saudi Chemical Society  
**Prof. Abdulrahman A. Alwarthan**  
Editor-in-Chief

2. Arabian Journal of Chemistry  
**Prof. Abdulrahman A. Alwarthan**  
Editor-in-Chief

# Petrochemical Research Chair (PRC)

Supervised by **Prof. Salem Al Deyab**

The laboratory of the chair consists of four research units as follow:

- Petrochemicals unit
- Catalysis unit
- Polymer & Nanofiber unit
- Microanalysis unit

The Department also hosts the

## Chemical Pollution Protection Committee (CPPC)

Headed by **Prof. Mahmood Monshey**

## Chemical Club

Supervised by **Dr. Ibrahim Aldrees.**





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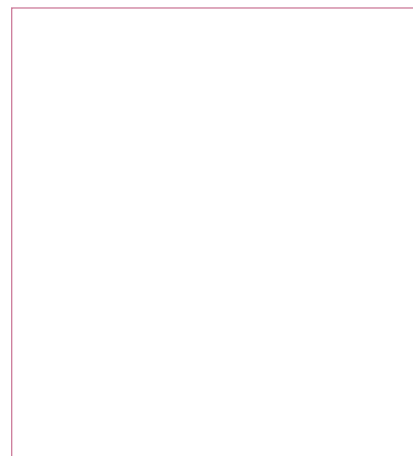
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