King Khalid University

College of Science

جامعة الملك خالد

كلية العلوم

Guidelines of Ph.D Program

A Thesis-Based Degree

Department of Chemistry


بسم الله الرحمن الرحيم

Guidelines of
Ph.D Program
A Thesis-Based Degree

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1. **Basic Information about the PhD Program**

Degree title: Doctor of Philosophy in Chemistry (دكتوراه الفلسفة في الكيمياء)

Degree type: Thesis-based with some courses (بالرسالة وبعض المقررات الدراسية)

Mission: To provide professional academicians and researches possessing in-depth knowledge, researching ability and technical capabilities to make positive impact through strategically managing risks associated with different chemistry divisions.

Vision: To aspire to excellence and leadership in the academic and research fields and to be among the internationally classified programs by 2030.

Goals

1. To preparation of qualified cadres in the field of university teaching, scientific research and its applications
2. To preparation of research projects aimed at addressing the relevant issues of society.
3. To support scientific competencies for creativity and innovation.
4. To enrich of scientific publishing in applied and developmental chemical research.
5. To encourage students from inside and outside the Kingdom to join the program.

2. Admission Requirements at the PhD Program

1. The applicant must be a Saudi or an official graduate grant if a non-Saudi
2. Holds a Master's of Science degree in chemistry or related topics from a Saudi university or a foreign recognized college or university with a grade "very good" or GPA = 3.75/5 or equivalent.
3. The College may accept "high good" and "good" grades, but the student average grade should not less than very good in the major field courses which the student intends to enroll in it.
4. Pass the GRE – subject (chemistry) with a minimum average of 50% or the admission tests determined by the department and the college.
5. The applicant should have at least an average of 70% (Master average (50%) + GRE (50%)). The Deanship of Graduate Studies has the authority to reduce this percentage to 60% in

some cases.

6. To pass one of the following English language tests:
    - IBT-TOEFL with a score of 59
    - IELTS with a score of 5.5
    - SEPT with a score of 80
7. To be a good conduct and medically fit.
8. To submit tow scientific recommendations from university professors who have already taught him.
9. Referential approval for the study from the employer if in employment.
10. The university and/or the college may add any other conditions that seem necessary for admission.
11. Payment of the tuition fees, if prescribed, before the start of the study and on the dates determined by the Deanship of Graduate Studies

3. Summary of the Chronological Sequence of Events in the PhD program

- Admission.
- Placement Examination.
- Fulfillment of remedial courses (if any) within the first year of enrollment.
- Fulfillment of course requirements.
- Choice of dissertation advisor; orientation in research, choice of field of research.
- Written and Oral Examinations.
- Admission to candidacy, and forming the Dissertation Examining Committee.
- Dissertation defense; Graduation.

4. Ph.D Degree Requirements

The completion of the PhD degree requires achieving the following three items:

1. Coursework: Successful completion of graduate-level coursework, as outlined in the approved Plan of Study.
2. Candidacy examinations
    a. Comprehensive Examinations: Passing at least four exams within first four semesters.
    b. Passing an oral preliminary exam: The oral examination by the student's advisory committee will include a discussion of the student's research (a written research summary must be submitted) and defense of an Original Research Proposal that is different from the student's thesis.
3. Ph.D Dissertation submission and defense.

5. Graduate Coursework and Requirements

5.1. Coursework

- The successful completion of twenty one (21) credit hours of coursework and twenty one (21) credit hours of Research (Ph.D. Dissertation) as a minimum are required.
- In the area selected as a major field (MF), the student will take the following as a minimum (2 core courses and 2 elective courses) as follows:
    1. Analytical - 12 hours of graduate level analytical chemistry courses
    2. Inorganic - 12 hours of graduate level inorganic chemistry courses
    3. Organic - 12 hours of graduate level organic chemistry courses
    4. Physical - 12 hours of graduate level physical chemistry courses
- In addition to the selected MF, the student will also take 9 hours of graduate level courses (3 courses selected from a series of courses proposed by the Graduate Committee) in the other fields.
- The student is also required to complete PhD Dissertation submission and defense: Submission of a dissertation of original research, including at least two peer-reviewed papers, and successfully defended in a public presentation and oral examination with a faculty committee.
- The maximum duration allowed is five years.

5.2. Written and Oral Examinations

Comprehensive examinations

- Students must obtain satisfactory performance on a series of written major field examinations, including special topics. The content of the exams generally covers the current literature, courses and seminars. (Student must get at least B grade).
- The series of tests are given at approximately one – month intervals. The candidate must pass four of eight examinations offered by the end of the second year.

Preliminary examination

Students must obtain satisfactory performance on a preliminary examination, written and oral parts in the following two types:

- Research progress: at the end of the fourth semester, the dissertation research summary has to be typically completed by the student.
- Original research proposal: in the fourth semester, an oral and written research proposal on a

topic distinct from the student's developing topic of dissertation research must be presented and discussed.

5.3. Department Requirements

(Exams, Courses, Seminars, Research work)

5.3.1. Placement Examinations

- All entering students must pass the Placement Exams. These exams are in the following areas: Inorganic, Organic, Physical, and Analytical. The results of the examinations will provide the Graduate Studies Committee information about the scientific backgrounds of individual students of the entering class.
- Students with deficiencies will be required to take two (2) courses or more within the first year of enrolment, remedial courses for which no credits will be given towards the Ph.D.

5.3.2. Miscellaneous courses

Students are required to take:

- four general courses (1 unit/each) in the first semester: 701-Chem Teaching (continuous during the second semester), 702-Chem Ethics(*),703-Chem Safety in the laboratory(*) and 704-Chem Chemical literature(*).
- one general course (1 unit) in the third and fourth semester (705-Chem Scientific Communication). The grade in such course is simply pass or fail.

* Only for students who have not already taken these courses in the Master Degree.

5.3.3. Seminars

- From the second semester, candidates for the Ph.D. degree are required to continually:
  - attend the department colloquium (751/752/753/754/755-Chem Departmental Seminar); seminars given by outside speakers (visiting scholars) or faculty member,
  - attend (or participate) the division seminar of the major subject (761/762/763/764/765-Chem M.F. Seminar.
- From the third semester, candidates for the Ph.D. degree are required to continually:
  - participate and present his advancement in his own research topic in the research group seminar in M.F with students' advisor (766/767/768/769-Chem M.F Group Seminar); seminar organized by a student's research group with their research advisors.
- Students must present a seminar in Graduate Research Seminar (GRS) or Graduate Research Conference (GRC) (756/757-Chem GRS) or make one presentation at the annual KKU Graduate School Symposium or an oral presentation at a regional or national research meeting.

5.3.4. Research work

A student must obtain satisfactory performance on the following:

1. 791-Chem Research Rotation 1 (Advanced Research)

First semester: students select a faculty advisor and pursue a research project in the laboratory of the faculty mentor. The students' progress and activity are monitored by a three-member faculty advisory committee. This course provides the student with the opportunity to apply the skills and techniques mastered in applied courses to a research problem.

2. 792-Chem Research Rotation 2 (Advanced Research)

Second semester: Students select a second faculty mentor, advisory committee, and research project. At the conclusion of this rotation, the student selects his/her dissertation mentor and dissertation topic.

3. 793-Chem Advanced Pre-Dissertation Research 1 (Ph.D. Pre- Dissertation)
4. 794-Chem Advanced Pre-Dissertation Research 2 (Ph.D. Pre- Dissertation)
5. 795-Chem Original Research Proposal : It must originate with the student and not be related to their doctoral research or prior research work.
6. 796-Chem Ph.D. Dissertation

5.3.5. Applied Courses

Based on the decision of the dissertation committee, the student will take one or more Applied Courses (Chem 77x/78x (x: 1-9) regarding to the deficiencies in the ability to monitor and deal with research work that are very important to need.

The student should sign the document which is given to him and write "**I hereby declare that I have read, understand and hereby accept the terms described in this document**".

6. Curriculum Study Plan Table

To facilitate the reading of the study plan table presented below, it is recommended to consider the following notes:

1. This plan is for student who passed the Entrance Exams.
2. Core, Elective and Applied courses are listed below.
3. M.F designates the major field (area of the specialty) chosen by the student: Physical, Analytical, Organic or Inorganic Chemistry.
4. Coding system: Each course has a code of the form 000-Chem ; (a) First digit: Program code (7) (b) Second digit: Course type code (Miscellaneous Courses (0), M.F courses (1 to 4: 1 for Organic, 2 for Inorganic, 3 for Physical, and 4 for Analytical), Seminars (5 and 6), Applied Courses (7 and 8), Research work (9), (c) Third digit: Course no. (1 to 9).

5. In the area selected as a major field (M.F) the student must take one of the two core courses in the first semester (Core course (M.F 1). The second course will have to be taken in the second semester.
6. Student must take one course (Elective course – nx; x: 1- 3) from each of the three other areas selected from course series which will be proposed by the Graduate Committee.
7. Student must take two elective courses in the area selected as a major field M.F.

7. PhD Plan

First Year			
First Semester			
Course Code**	**Course Title**	**Contact hour**	**Credit hour**
7x1 or 7x2-Chem	Core Course 1 (M.F)	3	3
$7n_1$1 or $7n_1$2-Chem	Elective Course – n_1	3	3
701-Chem	Teaching	1	0
702-Chem	Ethics*	1	0
703-Chem	Safety in the Laboratory*	1	0
704-Chem	Chemical Literature*	1	0
791-Chem	Research Rotation 1	3	0
Total		13	6
Second Semester			
7x2 or 7x1-Chem	Core Course 2 (M.F)	3	3
$7n_2$1 or $7n_2$2-Chem	Elective Course – n_2	3	3
701-Chem	Teaching	1	0
792-Chem	Research Rotation 2	3	0
Total		10	6
Second Year			
Third Semester			
7x3;4;5 or 6-Chem	Elective 1 (M.F)	3	3
$7n_3$1or $7n_3$2-Chem	Elective Course – n_3	3	3
705-Chem	Scientific Communication	1	0
793-Chem	Advanced Pre-Dissertation Research 1	3	0
Total		10	6
Fourth Semester			
7x3;4;5 or 6-Chem	Elective 2 (M.F)	3	3
705-Chem	Scientific Communication	1	0
794-Chem	Advanced Pre-Dissertation Research 2	3	0
795-Chem	Original Research Proposal	1	0
Total		8	3
Third Year			
Fifth Semester			
796-Chem	Ph.D. Dissertation		21
Sixth Semester			
796-Chem	Ph.D. Dissertation		-
			21
Total Credits			**42**

*For students who have not taken this course in Master Degree; **__x__: 1 for Organic, 2 for Inorganic, 3 for Physical, and 4 for Analytical whereas **n**: refers to the other fields except the specialty (e.g if x =1 (organic), n should be 2 Inorganic,3 Physical or 4 Analytical)

8. Course List

8.1. Core Courses

Organic	
711-Chem	Physical Organic Chemistry
712-Chem	Spectroscopic Organic Structure Determination
Inorganic	
721-Chem	Advanced Inorganic Chemistry I
722-Chem	Advanced Inorganic Chemistry II
Physical	
731-Chem	Quantum, Structure and Dynamics I
732-Chem	Chemical Thermodynamics
Analytical	
741-Chem	Separation Techniques
742-Chem	Spectroscopic Analytical Techniques

8.2. Elective Courses

Organic	
713-Chem	Advanced Organic Chemistry I
714-Chem	Advanced Organic Chemistry II
715-Chem	Advanced Synthetic Chemistry
716-Chem	Selected Topics in Organic Chemistry
Inorganic	
723-Chem	Inorganic Chemistry Synthesis
724-Chem	Radiations and nuclear chemistry
725-Chem	Group theory and their applications
726-Chem	Selected Topics in Inorganic Chemistry
Physical	
733-Chem	Chemical Kinects and Reaction Dynamics
734-Chem	Statistical Thermodynamics
735-Chem	Quantum, Structure and Dynamics II
736-Chem	Selected Topics in Physical Chemistry
Analytical	
743-Chem	Environmental Analytical Chemistry
744-Chem	Electroanalysis Chemistry
745-Chem	Bioanalytical Chemistry
746-Chem	Selected Topics in Analytical Chemistry

8.3. Applied Courses

771-Chem	Applied X-Ray structure determination
772-Chem	Applied mass spectroscopy: fundamental, instrumentation and techniques
773-Chem	Applied spectroscopic methods of structure determination
774-Chem	Applied quantitative methods of computational chemistry
775-Chem	Applied physical methods of inorganic chemistry
776-Chem	Applied separations
777-Chem	Applied NMR techniques
778-Chem	Applied statistics and Data analysis

779-Chem	Applied Phys. Meth. Material Chem
780-Chem	Applied scientific presentations
781-Chem	Applied research techniques
782-Chem	Applied mathematics in physical chemistry

9. Brief description of the program courses

9.1. Core courses

9.1.1. Organic Chemistry Track Courses

711-Chem Physical Organic Chemistry

The goal of this course is to mediate the principles of the relationships between structure and reactivity of organic molecules. These will include a review on structure, energy, and solvation and the influence of substituents on reactivity and activity; steric effects, stereo electronic effects, conformation analysis, orbital symmetry, thermodynamics and kinetics. The course is designed to dissect the different forces of molecules to increase the understanding of reactivity. This knowledge will help the organic chemistry student to pick appropriate solvents and reactants for chemical conversion and stimulate new ideas applicable for their research. The student will have the opportunity to present an important topic of physical organic chemistry. Additionally, we will discuss selected chemistry and biochemistry highlights.

712-Chem Spectroscopic Organic Structure Determination

This course covers advanced applications of modern techniques of spectroscopy used in structural elucidation of complicated organic compounds including Near-IR; MS; solid and liquid NMR (1D, 2D and 3D). This course will discuss also diffuse reflectance UV-Vis and advanced applications.

9.1.2. Inorganic Chemistry Track Courses

721-Chem Advanced Inorganic Chemistry I

This course offers students comprehensive studies in advanced inorganic chemistry fields. The course offers an advanced overview for f-block elements and discuss the magnetism and magnetic materials, put many advances in perspective and allow the students to make connection to related fields; advanced physical methods for materials chemistry studies, coordination complexes and coordination kinetics-thermodynamics. The course maintains advanced perspectives in the fields of catalysis and biological inorganic chemistry as well.

722-Chem Advanced Inorganic Chemistry II

This course offers students comprehensive review in advanced chemistry of inorganic materials which serves to put many advances in perspective and allow the students to make connection to

related fields, such as, magnetic materials, conductive materials and nanostructured inorganic materials. The course presents the students the recent developments in inorganic chemistry.

9.1.3. Physical Chemistry Track Courses

731-Chem Quantum Structure and Dynamics I

This is the first of a two-part course in Quantum, Structure and Dynamics. This course focuses on the essential principles, concepts and applications of electronic structures, quantum mechanism and quantum dynamics. It covers several topics including fundamental concepts, methods of Quantum Mechanics, Quantum theories, Ab initio Methods, Hartree-Fock, Post Hartree-Fock, Moller-Plesset Theory, Coupled Cluster Theory, Density Functional Theory, Semi-empirical methods, group theory, applications of electronic structure theory, time dependent quantum mechanics, and time dependent approach to spectroscopy.

732-Chem Chemical Thermodynamics

This course intends to train the students in the application of the concepts to problems that are commonly encountered by the chemist. The mathematical tools that are necessary for this purpose are considered in more detail than is usual. In addition, solving thermodynamic problems using computer simulations, graphical, numerical, and analytical, are described fully and are used frequently, both in illustrative and in assigned problems.

9.1.4. Analytical Chemistry Track Courses

741-Chem Separation Techniques

- Provides students with a solid grounding in the theory of chromatography, important considerations in its application, and modern instrumentation.
- Highlights the primary variables that students can manipulate, and how those variables influence chromatographic separations.
- Explain the application of chromatographic methods to actual, complex chemical samples.

742-Chem Spectroscopic Analytical Techniques

Instrumental analysis is divided into three branches; spectroscopy, electrochemistry and chromatography. This course is mainly based on spectroscopic instrumentation (Vis/UV, IR, AAS, ICP-OES, and ICP-MS) and analysis. The interaction of electromagnetic radiation with the matter in its state (gas, liquid and solid). The interaction will characterized as absorption, emission, refraction and scattering. Contents including fundamental theory, application and methods development will be widely covered throughout the course.

9.2. Elective courses

9.2.1. Organic Chemistry Track Courses

713-Chem Advanced Organic Chemistry I

This course will focus on a deeper understanding of the structure and reactivity of organic molecules with an emphasis on reaction mechanisms. It is a review of aspects of organic chemistry, covering pericyclic reactions, aldol additions and condensation reactions, advanced nucleophilic substitution, photochemistry, as well as introduction about the generation of free radicals.

714-Chem Advanced Organic Chemistry II

The course covers several topics with the focus mainly the following areas: Methods for functional group interconversion by Substitution Including Protection and Deprotection, Generation, properties and alkylation of Enolates and Other Carbon Nucleophiles, Reactions Involving Carbocations, Carbenes, and Radicals as Reactive Intermediates.

715-Chem Advanced Synthetic Chemistry

This course covers the advanced principles of retrosynthetic analysis and the chemistry of protecting groups. The course describes the natural products; their classes include (carbohydrates, peptides, proteins, nucleosides, nucleotides, nucleic acids, terpenes, alkaloids) and structures and biosynthesis.

716-Chem Selected Topics in Organic Chemistry

The objective of this course is to explore selected topics about the latest advancements in the field of Organic Chemistry; without obligation that these topics will related to the research area of the dissertation. As proposed topics:

Polymer for Advanced Technology: This course will focus on the polymer structure–property relationships that are based on well-known basic chemistry and physical relationships. Because such relationships build on one another you need to study in an ongoing manner. This course depends on firm foundations in all the core areas of chemistry. Each chapter emphasizes knowledge from one or more of these areas.

Biochemistry of Free Radicals and Antioxidants: Generation of free radicals and reactive species, the phenomenon of free radicals toxicity, the mechanisms of oxidative degradation of the biomolecules by free radicalsand the subsequent pathological changes; and the mechanisms of the antioxidant molecules in their elimination

9.2.2. Inorganic Chemistry Track Courses

723-Chem Inorganic Chemistry Synthesis

The course is an up-to-date review of the area of Inorganic Synthesis, providing the detailed foolproof information needed by lab chemists on procedures for the preparation of important and timely inorganic compounds. Inorganic chemistry synthesis, deals with synthesis and preparative chemistry under specific conditions: high temperature, low temperature and cryogenic, hydrothermal and solvothermal, high pressure, Chemical Vapor Deposition (CVD), photochemical and microwave. Synthesis of functional inorganic aggregates is discussed giving special attention to the assembly of nanomaterials.

724-Chem Radiations and Nuclear Chemistry

The course aims at acquiring the PhD students an advanced knowledge of nuclear chemistry and radiation chemistry, and nuclear chemistry and discuss the evidence for shell structure in nuclei. This course maintains the isotopes and the chart of nuclides, in addition, explain the precision mass spectrometry. Describe the radioactive decay and spontaneous nuclear transformation. Understand of the Fermi gas, shell, Nilsson and macroscopic–microscopic model. Describe the short-lived elementary particles in atoms and molecules and explain production of radionuclides, measurement of nuclear radiation, nuclear reactors and accelerators.

725-Chem Group theory and their Applications

The course provides the Ph.D. students advanced knowledge of several topics in symmetry and its role in chemistry. We will discuss point group theory and develop an understanding of the mathematical basis of symmetry and how this can simplify understanding the physical and chemical properties of molecules. We will apply this knowledge to understand the molecular vibrations (IR and Raman) of the molecules and their spectra, followed by several topics so that students can understand the advanced applications to chemical bonding and ligand field theory, and larger systems such as crystals as well as the use of symmetry in Nuclear Magnetic Resonance.

726-Chem Selected Topics in Inorganic Chemistry

The objective of this course is to explore selected topics about the latest advancements in the field of Inorganic Chemistry; without obligation that these topics will related to the research area of the dissertation. As proposed topics:

Green chemistry: This course highlights the potential and scope of green chemistry for clean and sustainable development. The course introduces many applications and benefits and advantages of environmentally friendly chemical practice and application in industry. The ecologically safe products, catalysts and solvents, conditions needed to produce such products, types of chemical

processes that are conducive to green chemistry will be introduced.
Advanced inorganic materials: This course includes the preparation of solid-state inorganic materials by chemical processing techniques. It also expands upon new chemical precursors available to materials scientists, the applications of those materials, and existing or emerging topics where materials chemistry plays an important role, such as in microelectronics, surface science, and nanotechnology. The characterization techniques and structure-property relationships, and materials classifications based on type and applications, including electronics, biomaterials, thin films, and coatings will be maintained.

9.2.3. Physical Chemistry Track Courses

733-Chem Chemical Kinects and Reaction Dynamics

It focuses on advanced concepts of Chemical Kinetics. It covers flow techniques, theories of reaction mechanism. It also concentrates on the details of the reaction dynamics (molecular scattering, potential Energy Surface, classical dynamics and molecular energy transfer).

734-Chem Statistical Thermodynamics

This course will cover the subject of statistical thermodynamics. The course will mainly focus on system in equilibria. We explore the general principles, from which emerge an understanding of the microscopic significance of entropy and temperature. We develops methods of quantum statistics and use them to calculate observable properties of systems in thermodynamic equilibrium. Topics treated include the principles of thermodynamics, canonical ensembles for quantum mechanical system, partition functions, chemical equilibrium. We consider a range of applications of quantum statistics. The course will elucidate the relation between thermodynamics and statistical mechanics, which are essential ingredients of many fields of physical chemistry and related science.

735-Chem Quantum Structure and Dynamics II

This is the second of a two-part course in Quantum, Structure and Dynamics. This course focuses on the advanced quantum chemical methods and applications in various fields, as well as group theory applications. It covers Monte Carlo method, Principles of Molecular mechanics, Born-Oppenheimer approximation, Principles of Molecular dynamics, Group theory and molecular electronic states, Molecular orbital theory and its applications, Spectroscopy – interaction of atoms and molecules with light, Applications of quantum dynamics in spectroscopy, Group Theory and its application to the Quantum Mechanics, Applications of group theory to structure, chemical bonding, molecular systems, and spectroscopy. In addition, it presents usage and application of Quantum Mechanics and Dynamics in biological, materials science, and chemical systems in order to understand the experimental results.

736-Chem Selected Topics in Physical Chemistry

The objective of this course is to explore selected topics about the latest advancements in the field of Physical Chemistry; without obligation that these topics will related to the research area of the dissertation. As proposed topics:

Advanced Electrochemistry: The course is divided into three parts. Fundamentals: this covers potential and thermodynamics of electrochemical cells, kinetics of electrode reactions, mass transport, electron transfer and electrical double layer. The electrolyte solutions and transport in solutions will also be covered in this part. Electrochemical Methods: this covers the basic technics in electrochemistry including potentiostatic and galvanostatic methods, cyclic voltammetry and electrochemical impedance spectroscopy. Applications: this covers, and not limited to, one or more of the following applications: electrochemical energy systems (batteries and fuel cells), corrosion phenomena and corrosion prevention, electrochemical device for water treatment.

Surface Chemistry and Catalysis: The course describes the physical chemistry of reactions on solid surfaces as they relate to current problems in heterogeneous catalysis. Experimental techniques, methods and data analysis used in modern surface chemistry research. The course links between surface chemistry and methods for the catalysts characterizations. The course covers fundamental and applied aspects of molecular adsorption/desorption, kinetics, surface analysis and instrumentation. Moreover, the course covers up-to-date applications of heterogeneous catalysis, especially green conversions and sustainable energy production.

Computational Chemistry: Topics will include platform choice, operation systems, systems requirements and installation of softwares. Additionally, modeling the behavior of chemical systems with emphasis on hands on experiments. Various properties of interests would be calculated by advanced quantum chemical approaches. The focus would be on structure-property relationship, photophysical, electronic, thermodynamical, structural, and charge transfer properties at molecular and bulk scales by density functional theory, time dependent density functional theory, molecular mechanics, molecular dynamics and accessible quantum chemical methods. Problems addressed will include topics in advanced functional materials, solar cells, energy minimization, molecular mechanics, molecular dynamics, spectroscopy prediction, charge transfer, electronic, optical, solid state bulk level, and biological systems.

9.2.4. Analytical Chemistry Track Courses

743-Chem Environmental Analytical Chemistry

This course is aimed to emphasize the concepts essential to the practice of environmental science, technology and chemistry while introducing the newest innovations in the field. The relationship of environmental chemistry to the key concepts of sustainability, industrial ecology and green chemistry is also considered.

744-Chem Electroanalysis Chemistry

Identifying the advanced techniques of Spectrophotometric Analysis Describing the different methods of Electrochemical Analysis Indicating the main components of spectrophotometrs, types of electrodes and cells used for potentiometric, conductometric, voltametric, polarographic, and amperometric analysis Analyzing UV and Visible spectra and chromatograms Solving some of spectrophotometric and electrochemical problems.

745-Chem Bioanalytical Chemistry

The contents of this course includes Quantitative Instrumental Measurements; Spectroscopic Methods for the Quantitation of Classes of Biomolecules; Enzymes and Quantitation of Enzymes and Their Substrates; Biosensors; Design of Macromolecular Reagents; Image-Based Bioanalysis; Electrophoresis; Centrifugation Methods; Chromatography of Biomolecules; Mass Spectrometry of Biomolecules; Micro-TAS, Lab-on-a-Chip, and Microarray Devices and Validation of New Bioanalytical Methods.

746-Chem Selected Topics in Analytical Chemistry

The objective of this course is to explore selected topics about the latest advancements in the field of Analytical Chemistry; without obligation that these topics will related to the research area of the dissertation. As proposed topics:

Food Analysis: The food analysis topic will be applied to illustrate the principles of selection and applying the advanced methods and techniques for chemical analysis to analyze the major, trace and the chemical contaminates residues constituents in the different types of foods, including studying the sample treatment techniques, data validation and analysis. Applying the Quality control and Quality Assurance programs for the applied method of analysis. The course will cover analysis of Fat, Protein, Carbohydrate, Vitamins, Antioxidant, trace metals, Food additives and total phenolic and pesticides contaminates residues. Comparison between the different approved and well-established standard methods of food analysis also will be studied.

Drug Analysis and Forensic Chemistry Applications: In this topic, definition and classification to the different types and categories of drugs (Acidic Drugs, Basic Drugs, Alkaloids and Nonalkaloids) and its chemistry and absorption in the body will be studied. In addition to applying the advanced methods and techniques for qualitative and quantitative analysis of drugs in the different formulations. Applying the Quality control and Quality Assurance programs for the applied method of analysis. The topic also will be covering the forensic chemistry analysis for drugs, toxic, explosive, Inks and paints materials.

9.3. Miscellaneous Courses

701-Chem Teaching (for two semesters)

This course is associated with the study of the different science teaching methods including the teacher centered, learner centered, content focused and interactive methods. Students enroll for 2 units of Chemistry during the semesters in which they serve as teaching assistants.

702-Chem Ethics

The course addresses the most important ethical concepts, theories, questions and rules of relevance to chemistry research in all its aspects including normative ethics, research ethics and ethical issues related to risk assessments. The course will convey different concepts to make students familiar with the role of chemistry in society, the ethical problems related with chemistry and the ethical responsibilities of chemists.

703-Chem Safety in the laboratory

This course is based on basic safety measures and basic standards in laboratory at University level. To enhance the knowledge of students for effective practicing the health and safety's regulations in Chemistry laboratories. In addition, students will develop their skills of the daily practice related to health and safety in laboratory. Moreover, students will be trained on real laboratory's situation and how to react and response to such situation.

704-Chem Chemical literature

A survey of the tools employed for the effective and efficient search and the retrieval and analysis of chemical information including online databases, chemical abstracts, patents, handbooks, encyclopedias, and comprehensive works. Types of information in technical publications; exercises in finding, assembling, and using such data.

705-Chem Scientific Communication (2^{nd} year)

First term: The course objective is to teach students how to evaluate and begin to write scientific documents, specifically a journal paper. It covers a wide range of topics such as literature searching using online databases, components of abstracts and construction of hypotheses. The course also prepares graduate students for written part of Research Rotation I.

Second term: This course is a continuation of Scientific Communication I. It specifically concentrates on various aspects of preparing and writing a scientific research proposal and an original research proposal. The course also prepares graduate students for the written and oral portions of Research Rotation II.