B.Sc. CHEMISTRY ACADEMIC PROGRAM GUIDE

2022

Contents

Introduction

Chemistry has been described as the central science, having strong interactions with biology, medicine, engineering, environmental sciences, physics, and mathematics. Chemistry helps you to understand the world around you, because chemical matter includes the entire physical world, such as the things we use, the food we eat, and even ourselves.

The Department of Chemistry provides the opportunity for the students to obtain a thorough fundamental knowledge of various fields of chemistry such as (but not limited to) organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry, and biochemistry.

Close student-faculty interactions have been a hallmark of our department. The caring and supportive attitude of faculty members creates confidence and enthusiasm in the students to reach where they aspire to be.

The faculty members in the department share the responsibility together to make the department 'The best in the University'. Our facilities are continuously expanding, and we are modernizing our laboratories and improving upon education. We are marching forward to blend chemistry education with latest advances in chemical research and introducing relevant courses to keep pace with modern chemistry.

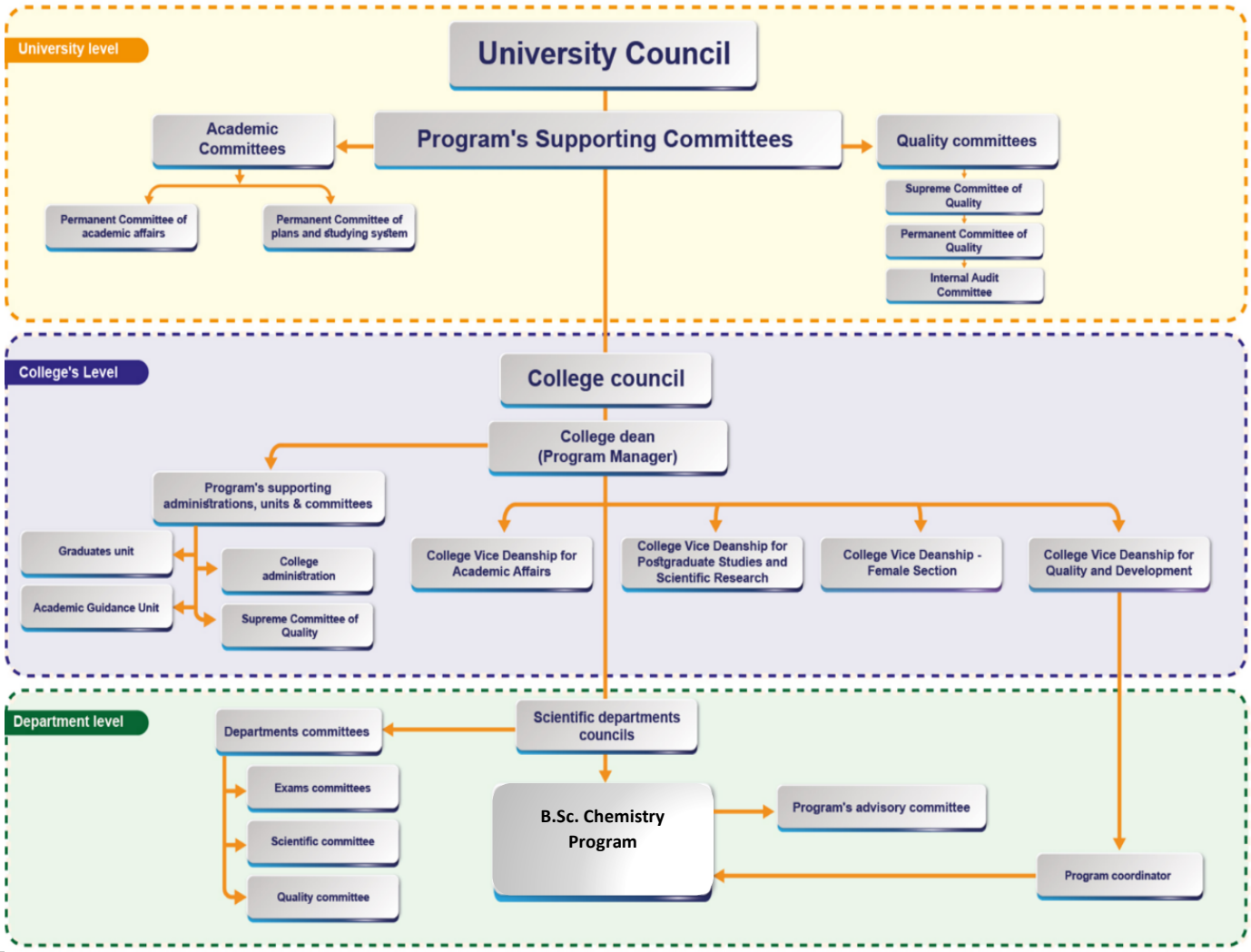
Program Mission

The program is committed to prepare scientifically distinguished graduates in the field of chemistry and its applications by acquiring scientific skills that keep pace with the needs of the labour market, producing applied research, and providing chemical consultations to serve the community.

Program Goals

1. Preparing a distinguished graduate with knowledge and skills in chemistry.
2. Qualifying students to adapt to the developments and needs of the labor market in the field of chemistry.
3. Providing chemical consultations to the public and private sectors.
4. Conducting chemical research in line with national research priorities.

Organization Chart of Program



Admission Requirements

According to the Kingdom of Saudi Arabia Universities Act and the recommendation of the colleges and other concerned bodies of the University, the University council resolves the total number of newly accepted students each academic year.

The admission requirements are:

1. The student should have the secondary school certificate or its equivalent from inside or outside the kingdom of Saudi Arabia.
2. The student must provide the certificates of performance on aptitude (Qudrat) and proficiency (Tahseeli) tests.
3. The student should have obtained the secondary school certificate in a period of less than 5 years prior to the date of application. However, the University Council may waive this condition if the applicant has a satisfactory explanation.
4. The student must have a record of good conduct.
5. The student must successfully pass any examination or personal interviews as determined by the University Council.
6. The student must obtain the approval of his employer if he is employee of any government or private agency.
7. The student must satisfy any other conditions the university council may deem necessary at the time of application.

8. All students apply for this program must successfully complete 28 credit hours for male and 27 credit hours for female in the preparatory year program as distributed follows:

Course Code	Course Title	Credit hours	Course Code	Course Title	Credit hours
PENG 001	English Level 1	3	PENG 003	English Level 3	3
PENG 002	English Leve 2	3	PENG 006	English Level 4	3
PMAT 001	Math Level 1	2	PMAT 003	Math Level 3	2
PMAT 002	Math Level 2	2	PMAT 004	Math Level 4	2
PCOS 001	Computer skills	2	PELE 001	Introduction to E-learning	2
PLSK 001	Self-development skills	2	PPHC 001(F) PHFI 001(M)	Public Health Health and Fitness	1 2
Total		**14**	Total male Total female		**14** **13**

Graduation Requirements

The studying cycle of the B.Sc. chemistry program is four years spitted into eight semesters. By the end of the 8th semester, a bachelor's degree of Science in Chemistry is awarded upon fulfillment of the following graduation requirements:

1. All students working for their bachelor's degree in chemistry must successfully complete 132 credit hours distributed as follows:

Requirements		Credit Hours
University Requirements	Compulsory Courses	15
Faculty Requirements	Compulsory Courses	27
Departments Requirements	Compulsory Courses	80
	Elective Courses	10
	Total Credit Hours	**132**

2. Have a minimum cumulative Grade Point Average (GPA) of one out of four (1.0 out of 4.0).

Academic Reference Standards of Program

The Academic Reference Standards represent general expectations about the standards for the award of qualifications at the B.Sc. degree in chemistry and articulate the attributes and capabilities that the graduates should be able to demonstrate. The undergraduates of chemistry programs should provide students with an education in the main branches of chemistry, namely:

1. Analytical chemistry: study of the structure, composition, and analysis of substances.
2. Inorganic chemistry: study of non-carbon-based compounds.
3. Organic chemistry: study of carbon-based compounds.
4. Physical chemistry: application of concepts and laws to study the characteristics of atoms and molecules as well as chemical reactions. Also, study of the principles and theories of quantum mechanics.

Distinctive characteristics of the graduates of chemistry program:

The graduates of the Chemistry should be able to:

1. Recognize the basic principles and theories of chemistry in the development of society.
2. Apply information technology in chemistry and develop his/her professional career.
3. Design and carry out the chemical experiments and estimate the chemical problems and develop solution strategies.
4. Employ scientific facts and theories to analyze, interpret and present practical data using appropriate formats and techniques.
5. Implement self and long life-learning and participate effectively in research activities.

6. Discuss what's up to date in chemistry field.
7. Initiate, develop and implement new ideas.
8. Communicate well with his/her colleagues from different social and cultural backgrounds under professional working conditions.

Program Intended Learning Outcomes (PLOs)

Knowledge and Understanding:

K1. Describe the structure, reactivity and properties of chemical substances, and various chemical reactions.

K2. Explain basic concepts, principles, and theories across the four principal areas of chemistry such as organic, inorganic, physical and analytical chemistry.

K3. Find a relationship between the fundamental concepts and theories of chemistry, and their contribution to applied chemistry.

K4. Retrieve ethical, linguistic, and scientific information from the allied subjects for better understanding and proper use of chemistry.

Skills:

S1. Conclude the structure/composition of a chemical compound based on its chemical and physical properties.

S2. Build pathways and/or mechanisms for physical and chemical processes.

S3. Solve scientific problems using mathematical expressions, procedures, and mechanisms.

S4. Apply communication and information technology skills for scientific writing, presentation, and problem solving in chemistry.

S5. Use the experimental laboratory data to identify the characteristics and physical properties of the chemicals/system.

S6. Prepare experimental setup in a safe and proper manner to perform chemical synthesis and analysis.

Values:

V1. Perform the tasks independently as well as in a team with professional values and ethics.

V2. Choosing the required tools and equipment for the preparation and analysis of the desired compounds with certain responsibility.

Study Plan of Program

Study plan presents the distribution of courses against each semester (overall, 4 years / 8 semesters). The study plan includes the following:

University-requirement courses (15 credit hours, compulsory):

The goal of these courses is to improve students' skills in English language and to develop moral and ethical values of students. These courses include an English course (ENGL 110), Arabic courses (ARAB 101, and 102), and Islamic culture courses (IC 101, 102, 103, and 104).

Faculty-requirement courses (27 credit hours, compulsory):

These courses cover the basic scientific, English language and programming courses. These courses include basic science courses (BIOL 101, CHEM 101, MATH 101, PHYS 100, and PHYS 101), English courses (ENGL 101, and 102), and a computer course (ICS 103).

Department-requirement courses for the program (90 credit hours):

These courses covering all major branches of chemistry: organic, analytical, physical and inorganic chemistry. Each course is constructed to be consecutive to its prerequisite course. These courses include a mathematics course (MATH 200), a physics course (PHYS 201), and chemistry courses (codes start with CHEM, except CHEM 101).

Among the 90 credit hours of chemistry courses, 80 credit hours are compulsory chemistry courses and 10 credit hours are elective chemistry courses. Student can select their choice of elective courses from the offered elective courses, listed at the end of the study plan.

FIRST YEAR - FIRST SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
ARAB 101	Arabic language skills	2	2	0	-
ENGL 110	Writing Skills	3	3	0	-
IC 101	Introduction to Islamic culture	2	2	0	-
MATH 101	Calculus I	4	4	0	-
PHYS 100	Renewable Energy	2	2	0	-
PHYS 101	General Physics I	4	3	3	Co-MATH 101
	Total	**17**	**16**	**3**	

FIRST YEAR - SECOND SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
ARAB 102	Arabic Composition	2	2	0	-
BIOL 101	General Biology	4	3	3	-
CHEM 101	General Chemistry I	4	3	3	-
ENGL 101	English Composition I	3	3	0	-
IC 102	Islamic and Society Building	2	2	0	-
ICS 103	Computer Programming	3	2	3	MATH 101
	Total	**18**	**15**	**9**	

Cr. = Credit hours, **Lect.** = Lecture hours, **Lab.** = Lab hours

Co- (in the pre-requisite column) = Co-requisite

SECOND YEAR - FIRST SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
CHEM 102	General Chemistry II	4	3	3	CHEM 101
CHEM 115	Instruments and Lab. Safety	1	1	0	CHEM 101
CHEM 273	Organic Chemistry I	2	2	0	Co-CHEM 102
CHEM 286	Chemistry of Main Group Elements	2	2	0	Co-CHEM 102
CHEM 293	Volumetric and Gravimetric Analysis	4	3	3	Co-CHEM 102
ENGL 102	English Composition II	3	3	0	ENGL 101
IC 103	Economic System in Islam	2	2	0	-
	Total	**18**	**16**	**6**	

SECOND YEAR - SECOND SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
CHEM 262	Chemical Thermodynamics	3	3	0	CHEM 102 Co-MATH 200
CHEM 274	Organic Chemistry II	2	2	0	CHEM 273
CHEM 275	Practical Organic Chemistry I	2	0	6	CHEM 273 Co-CHEM 274
CHEM 287	Chemistry of Transition Metals	2	2	0	CHEM 286
CHEM 294	Methods of Spectroscopic Analysis	2	2	0	CHEM 293
IC 104	Basics of Political System	2	2	0	-
MATH 200	Mathematics	2	2	0	MATH 101
PHYS 201	General Physics for Scientist	2	2	0	PHYS 101
	Total	**17**	**15**	**6**	

THIRD YEAR - FIRST SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
CHEM xxx	Elective (1)	2	2	0	*
CHEM 310	Nano-Chemistry	2	2	0	CHEM 102
CHEM 366	Electrochemistry	2	2	0	CHEM 262
CHEM 367	Practical Physical Chemistry I	2	0	4	CHEM 262 Co-CHEM 366
CHEM 371	Organic Reaction Mechanism	2	2	0	CHEM 274
CHEM 385	Coordination Chemistry	3	2	3	CHEM 287
CHEM 392	Electroanalytical Techniques	2	2	0	CHEM 293
CHEM 393	Environmental Analysis	2	2	0	CHEM 294
	Total	**17**	**14**	**7**	

* Pre-requisite vary depending on the elective course

THIRD YEAR - SECOND SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
CHEM xxx	Elective (2)	2	2	0	*
CHEM xxx	Elective (3)	2	2	0	*
CHEM 312	Biochemistry	2	2	0	CHEM 274
CHEM 368	Chemical Kinetics	2	2	0	CHEM 262
CHEM 376	Organic Spectroscopy	2	2	0	CHEM 274
CHEM 377	Polymer Chemistry	2	2	0	CHEM 371
CHEM 387	Solid State Chemistry	2	2	0	CHEM 286
CHEM 394	Practical Instrumental Analysis	2	0	4	CHEM 294 CHEM 392
	Total	**16**	**14**	**4**	

FOURTH YEAR - FIRST SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
CHEM xxx	Elective (4)	2	2	0	*
CHEM 461	Quantum Chemistry	2	2	0	CHEM 262
CHEM 470	Heterocyclic Chemistry	2	2	0	CHEM 371 CHEM 376
CHEM 478	Practical Organic Chemistry II	2	0	6	Co-CHEM 470
CHEM 480	Applied Inorganic Chemistry	2	1	3	CHEM 385
CHEM 483	Nuclear and Radiation	2	2	0	CHEM 286 CHEM 368
CHEM 493	Chromatographic Separation Methods	2	1	2	CHEM 394
	Total	**14**	**10**	**11**	

SECOND SEMESTER					
Code	**Course Title**	**Cr.**	**Lec.**	**Lab.**	**Pre-requisite**
CHEM xxx	Elective (5)	2	2	0	*
CHEM 466	Surface and Catalysis	2	2	0	CHEM 262 Co-CHEM 368
CHEM 467	Practical Physical Chemistry II	2	0	6	CHEM 368 CO-CHEM 466
CHEM 479	Petrochemicals	2	2	0	CHEM 274
CHEM 488	Organometallic Chemistry	2	2	0	CHEM 385
CHEM 495	Applied Analytical Chemistry	2	1	3	CHEM 493
CHEM 497	Research Project	3	0	6	100 earned Cr., Dept. Approval
	Total	**15**	**9**	**15**	

ELECTIVE COURSES FOR CHEMISTRY PROGRAM (10 hours)					
Code	**Course Title**	**Cr.**	**Lect.**	**Lab.**	**Pre-Requisite**
CHEM 314	Green Chemistry	2	2	0	CHEM 274
CHEM 318	Biochemistry II	2	2	0	CHEM 312
CHEM 319	Industrial Chemistry	2	2	0	CHEM 102
CHEM 369	Physical Chemistry of Polymers	2	2	0	CHEM 262 CO-CHEM 377
CHEM 381	Symmetry and Point Group Theory	2	2	0	CHEM 387
CHEM 395	Water Treatment	2	2	0	CHEM 294
CHEM 413	Statistics for Chemists	2	2	0	MATH 101
CHEM 465	Applied Physical Chemistry	2	2	0	CHEM 366
CHEM 468	Colloid Chemistry	2	2	0	CHEM 262, CO-CHEM 368
CHEM 473	Natural Products	2	2	0	CHEM 274
CHEM 476	Advanced Organic Synthesis	2	2	0	CHEM 274
CHEM 487	Bioinorganic Chemistry	2	2	0	CHEM 385
CHEM 489	Cluster Chemistry	2	2	0	CHEM 385
CHEM 498	Drug Analysis	2	2	0	CO-CHEM 493

Courses Description

FACULTY-REQUIREMENT COURSE (OFFERED BY CHEMISTRY DEPT.)

CHEM 101 - General Chemistry 1 (4 credits: 3 h lecture, 3 h lab)

Course content: The goal of this course is to understand the general concept of chemical foundation, atoms, molecules, ions, stoichiometry, types of chemical reactions, solution stoichiometry, gases, thermochemistry, atomic structure and periodicity, and general concept of chemical bonding.

Practical part: 12 experiments related to the theoretical topics.

Reference Textbook: N. J. Tro, Principles of Chemistry: A Molecular Approach, International Edition, New Jersey, Pearson Education Inc., 2010, ISBN: 0321809246.

COMPULSORY CHEMISTRY COURSES FOR THE PROGRAM

CHEM102 - General Chemistry II (4 credits: 3 h lecture, 3 h lab)

Pre-requisite: CHEM 101 - General Chemistry 1

Course content: The goal of this course is to understand the general concept of liquids, solids, properties of solutions, chemical kinetics, chemical equilibrium, acids and bases, spontaneity, entropy, free energy, and electrochemistry.

Practical part: 12 experiments related to the theoretical topics.

Reference textbook: N. J. Tro, Principles of Chemistry- A Molecular Approach, International Edition, New Jersey, Pearson Education Inc., 2010, ISBN: 0321809246.

CHEM 115 - Instruments and Lab. Safety (1 credit: 1 h lecture)

Pre-requisite: CHEM 101 - General Chemistry 1

Course content: This course aims to understand the general concept of standards of

security and safety in laboratories and identify safety equipment, first aid, emergency procedures and evacuation, to classify chemicals and store them safely.

Reference textbooks: 1) A. Keith Furr, CRC Handbook of Laboratory Safety, 5th edition, Boca Raton, CRC Press, 2000, ISBN: 0849325234. 2) R. Scott Stricoff and Douglas B. Walters, Handbook of Laboratory Health and Safety, 2nd edition, New Jersey, Wiley, 1995, ISBN: 047102628XI.

CHEM 262 - Chemical Thermodynamics (3 credits: 3 h lecture)

Pre-requisite: CHEM 102 - General Chemistry II, *Co-requisite:* MATH 200 - Mathematics

Course content: The goal of this course is to understand the general concepts of the laws of thermodynamics, gases' laws, phase rule, Clapeyron equation, mixtures, partial molar quantities, phase diagrams and equilibrium.

Reference textbooks: 1) P. Atkins, J. De Paula, Atkins' Physical Chemistry, 10th edition, Oxford, Oxford University Press, 2014, ISBN: 978-0199697403. 2) T. Engel and P. Reid, Physical Chemistry, 2nd edition, New Jersey, Pearson Education Inc., 2010, ISBN: 0-321-64305-4. 3) K. J. Laidler, J. H. Meiser, and B. C. Sanctuary, Physical Chemistry, 4th edition, California, Cengage Learning, 2003, ISBN: 978-0-618-12341-4.

CHEM 273 - Organic Chemistry I (2 credits: 2 h lecture)

Co-request: CHEM 102 - General Chemistry II

Course content: The goal of this course is to understand the origins of organic chemistry and chemical bonding, aliphatic hydrocarbons: structure, nomenclature, stereochemistry (confirmation of alkane, stereochemistry of cycloalkanes and alkenes, synthesis and reactions of alkynes, aromatic hydrocarbons: benzene, aromaticity, nomenclature, and reactions (activation and orientation).

Reference textbook: L. G. Wade, Organic Chemistry, 7th edition, New Jersey, Pearson Education Inc., 2010, ISBN: 0-321-61006-7.

CHEM 274 - Organic Chemistry II (2 credits: 2 h lecture)

Pre-requisite: CHEM 273 - Organic Chemistry I

Course content: This course covers Classification, nomenclature, physical properties, synthesis and reactions of the following organic classes: Alcohols (diols & thiols), ethers, epoxides, phenols, aldehydes, ketones, carboxylic (and their derivatives) and amines.

Reference textbook: L. G. Wade, Organic Chemistry, 7th edition, New Jersey, Pearson Education Inc., 2010, ISBN: 0-321-61006-7.

CHEM 275 - Practical Organic Chemistry I (2 credits: 6 h lab)

Pre-requisite: CHEM 273 - Organic Chemistry I, ***Co-request:*** CHEM 274 - Organic Chemistry II

Course content: This course contains labs that teach basic techniques in organic chemistry such as purification, filtration, recrystallization, sublimation, isolation, extraction thin-layer, column chromatography, and compositional analysis of organic molecules. Students will learn the techniques of various chemical reactions that lead to the identification of different functional groups.

Reference textbook: R. L. Shriner et Al, The systematic identification of organic compounds, 8th edition, New Jersey, Wiley, 2004, ISBN: 978849571887-7.

CHEM 286 - Chemistry of the Main Group Elements (2 credits: 2 h lecture)

Co-request: CHEM 102 - General Chemistry II

Course content: This course involves topics in basic inorganic chemistry which cover atomic structure, molecular structure and bonding, ionic bonding: lattice energy, packing and ionic sizes, Born-Haber cycle and applications, aqueous solutions, acids and bases,

periodic properties of the elements and the chemistry of selected main group elements and their associated compounds.

Reference textbook: C. E. Houscroft and A. G. Sharpe, Inorganic Chemistry, 3rd edition, New Jersey, Pearson Education Inc., 2007, ISBN: 978-0-13-175553-6.

CHEM 287 - Chemistry of the Transition Metals (2 credits: 2 h lecture)

Pre-requisite: CHEM 286 - Chemistry of the Main Group Elements

Course content: This course describes the chemistry of the transition metal elements. The course covers the following areas explicitly: occurrence, extraction and uses, physical properties and comparison with f block elements, general chemical properties and comparison with f block elements (Color, Variable oxidation states, Complex formation, Magnetic susceptibility and Catalysis) and lanthanide Contraction. A detailed study of the first row elements (their occurrence, extraction and uses, physical properties, and compounds formed in different oxidation states).

Reference textbook: C. E. Houscroft and A. G. Sharpe, Inorganic Chemistry, 3rd edition, New Jersey, Pearson Education Inc., 2007, ISBN: 978-0-13-175553-6.

CHEM 293 - Volumetric and Gravimetric Analysis (4 credits: 3 h lecture, 3 h lab)

Co-request: CHEM 102 - General Chemistry II

Course content: The goal of this course is to understand calculations used in analytical chemistry; aqueous solutions and chemical equilibria, titrimetric methods of analysis, principle of neutralization titration, application of neutralization titration, precipitation titrimetry, complexation reactions and titrations, application of oxidation/reduction titrations, principles of gravimetric analysis, application of gravimetric methods and calculation in gravimetric analysis.

Practical part: 12 experiments related to the theoretical topics.

Reference textbook: D. A. Skoog, D. M. West, F. J. Holler and S.R. Crouch, Analytical

Chemistry: An Introduction, 8th edition, California, Cengage Learning, 2007, ISBN: 0-534-41797-3.

CHEM 294 - Methods of Spectroscopic Analysis (2 credits: 2 h lecture)

Pre-requisite: CHEM 293 - Volumetric and Gravimetric Analysis

Course content: The main objective of this course is to familiarize students with the current spectroscopic analysis techniques used in various analytical applications through learning their operation, design, problem, and linking the outcome of these instruments with meaningful information.

Reference textbooks: 1) D. A. Skoog, D. M. West, F. J. Holler and S.R. Crouch, Analytical Chemistry: An Introduction, 8th edition, California, Cengage Learning, 2007, ISBN: 0-534-41797-3. 2) D. A. Skoog, F. J. Holler, S. R. Crouch, Principles of Instrumental Analysis, 6th edition, California, Cengage Learning, 2006, ISBN: 0495012017.

CHEM 310 - Nano-Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 102 - General Chemistry II

Course content: The first part of this course focuses on the nano-materials synthesis, stabilization and characterization. The second part explains the effect of the size on the chemical, electrical, physical and optical properties of nano-materials. The last part will be dedicated to the presentation of some nano-materials applications, and their contribution in the improvement of our daily lives.

Reference textbook: G. B. Sergeev, Nanochemistry, Amsterdam, Elsevier B.V., 2006, ISBN: 0-444-51956-4.

CHEM 312 - Biochemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 274 - Organic Chemistry II

Course content: This course is intended to offer a basic understanding on the scientific basis of life processes. The course deals with the classification, structure, chemical properties of major biomolecules such as carbohydrates, lipids, proteins and nucleic acids with the emphasis on its biological significance. It also covers the properties of water (medium of life) and the regulation of pH of biological fluids by buffers. At the end of the course, the students can demonstrate the knowledge of chemical processes that take place in living organisms.

Reference textbook: L. A. Moran, R. A Horton, G. Scrimgeour and M. Perry, and D. Rawn, Principles of Biochemistry, 5th edition, New Jersey, Pearson Education Inc., 2013, ISBN: 1292021748.

CHEM 366 - Electrochemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 262 - Chemical Thermodynamics

Course content: The goal of this course is to understand the general concepts of solution of electrolytes, electrochemical cells, types of electrodes, polarization of electrodes and corrosion of metals.

Reference textbooks: 1) K. J. Laidler, J. H. Meiser, and B. C. Sanctuary, Physical Chemistry, 4th edition, California, Cengage Learning, 2003, ISBN: 978-0-618-12341-4. 2) P. R. Roberge, Corrosion Engineering: Principles and practices, New York, McGraw-Hill, 2008, ISBN: 0-07-164087-8. 3) P. Atkins, J. De Paula, Atkins' Physical Chemistry, 10th edition, Oxford, Oxford University Press, 2014, ISBN: 978-0199697403.

CHEM 367 - Practical Physical Chemistry I (2 credits: 4 h lab)

Pre-requisite: CHEM 262 - Chemical Thermodynamics, ***Co-requisite:*** CHEM 366 - Electrochemistry

Course content: This course covers two parts: The first part (12 experiments) covers the general concepts of gas laws, heat transfer during chemical and physico-chemical

reactions, partial molar quantities, colligative properties, phase diagrams, and viscosity measurements. The second part (12 experiments) covers the general concept of electron transfer during chemical reactions. It includes an overview on electrolytic solutions, electrochemical reactions, techniques used in titration, corrosion, and electrolysis.

Reference Textbook: C. W. Garland, J. W. Nibler, D. P. Shoemaker, Experiments in physical Chemistry, 8th edition, New York, McGraw-Hill, 2009, ISBN: 978-0-07-282842-9.

CHEM 368 - Chemical Kinetics (2 credits: 2 h lecture)

Pre-requisite: CHEM 262 - Chemical Thermodynamics

Course content: The goal of this course is to understand the reaction rate and factors affecting the rate, simple reactions, basic experimental methods of measuring reaction rate, kinetics of composite reactions, Arrhenius equation, theories of reaction rates, and Kinetic Theory of gases.

Reference textbooks: 1) K. J. Laidler, J. H. Meiser, and B. C. Sanctuary, Physical Chemistry, 4th edition, California, Cengage Learning, 2003, ISBN: 978-0-618-12341-4. 2) P. Atkins, J. De Paula, Atkins' Physical Chemistry, 10th edition, Oxford, Oxford University Press, 2014, ISBN: 978-0199697403.

CHEM 371 - Organic Reaction Mechanism (2 credits: 2 h lecture)

Pre-requisite: CHEM 274 - Organic Chemistry II

Course content: Determination of reaction mechanisms via the physical and chemical properties of organic compounds, and by studying nucleophilic substitution reactions, electrophilic substitution reactions, elimination reactions, free radical reactions, addition reactions to carbon-carbon multiple bonds, addition reactions to carbon-oxygen double bonds, rearrangement and redox reactions.

Reference textbook: M. Edenborough, Organic Reaction Mechanisms: A step by step approach, 2nd edition, Boca Raton, CRC Press, 1999, ISBN 0748406417.

CHEM 376 - Organic Spectroscopy (2 credits: 2 h lecture)

Pre-requisite: CHEM 274 - Organic Chemistry II

Course content: The goal of this course is to understand the electromagnetic spectrum: extensive study of the following spectroscopic methods, UV and visible, IR spectroscopy, 1H- NMR and 13C-NMR spectroscopy, mass spectroscopy and solving problems by applying various spectroscopic data.

Reference textbook: D. L. Pavia, G. M. Lampman, G. S. Kriz, and J. A. Vyvyan, Introduction to spectroscopy, 4th edition, California, Cengage Learning, 2009, ISBN: 0495114782.

CHEM 377 - Polymer Chemistry (2 credits: h lecture)

Pre-requisite: CHEM 371 Organic Reaction Mechanism

Course content: The goal of this course is to provide an overview of the chemistry and physics of polymers. The structures and mechanisms of most important polymers are discussed, including step and chain polymerization reactions, as well as polymer modification chemistry. The physical properties and characterization (molecular weight and mechanical properties) of polymers are covered.

Reference textbook: P. C. Hiemenz and T. P. Lodge, Polymer Chemistry, 2nd edition, Boca Raton, CRC Press, 2007, ISBN: 1574447793.

CHEM 385 - Coordination Chemistry (3 credits: 2 h lecture, 3 h lab)

Pre-requisite: CHEM 287 - Chemistry of Transition Metals

Course content: This course introduces the basic principles of coordination chemistry

involving the following areas: Werner's theory, chemical nomenclature, stereochemistry and isomerism of coordination compounds; theories of bonding in coordination compounds; ligand field stabilization energies; the Jahn-Teller Effect; magnetic properties of transition metal complexes; electronic spectroscopy, term symbols and the spectrochemical series; chelate effects. A brief study of the coordination compounds of lanthanides (generally) and coordination compounds of thorium, plutonium and uranium.

Practical part: 12 experiments related to the theoretical topics.

Reference textbook: C. E. Houscroft and A. G. Sharpe, Inorganic Chemistry, 3rd edition, New Jersey, Pearson Education Inc., 2007, ISBN: 978-0-13-175553-6.

CHEM 387 - Solid State Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 286 - Chemistry of Main Group Elements

Course content: This course examines the fundamental concepts of the two main classes of solid state materials. Indeed, crystalline and amorphous materials will be studied and characterized through the following themes: Electronic materials, crystals and crystal defects, amorphous materials and solid solutions.

Reference textbook: W. D. Callister, Materials Science and Engineering, 7th edition, New Jersey, Wiley, 2007, ISBN: 0-471-73696-1.

CHEM 392 - Electroanalytical Techniques (2 credits: 2 h lecture)

Pre-requisite: CHEM 293 - Volumetric and Gravimetric Analysis

Course content: This course will discuss the theory and instrumental techniques that encompass static and dynamic electroanalytical measurements. Topics will include potentiometry, voltammetry, coulometry, basic instrumentation/ operation, and new applications. Focus will be on analytical applications and utilizing the correct technique

for solving specific analysis problems.

Reference textbook: D. A. Skoog, D. M. West, F. J. Holler and S.R. Crouch, Fundamentals of Analytical Chemistry, 8th edition, California, Cengage Learning, 2004, ISBN: 0-534-41797-3.

CHEM 393 - Environmental Analysis (2 credits: 2 h lecture)

Pre-requisite: CHEM 294 - Methods of Spectroscopic Analysis

Course content: The goal of this course is to introduce multi-media sampling techniques and analytical methods for the evaluation of outdoor and indoor air, soil/surface and water (transport of pollutants in the environment and their analysis, water, gas and land analysis). This course will focus also on the environmental quality control.

Reference textbook: R. N. Reeve, Introduction to Environmental Analysis, New Jersey, Wiley, 2002, ISBN: 0-471-49295-7.

CHEM 394 - Practical Instrumental Analysis (2 credits: 4 h lab)

Pre-requisite: CHEM 294 - Methods of Spectroscopic Analysis, CHEM 392 - Electroanalytical Techniques

Course content: The goal of the first part (12 experiments) is to illustrate and combine the most common modern electroanalytical techniques and applications in different fields and to get a fundamental understanding of the theoretical basis of measurements. The goal of the second part (12 experiments) is to solve problems by applying various spectroscopic data and help students to obtain practical knowledge of how to carry out meaningful interpretation of data from analytical chemical measurements.

Reference textbook: 1) J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, Vogel's quantitative chemical analysis, 6th edition, New Jersey, Prentice Hall, 2000, ISBN: 0582226287. 2) D. A. Skoog, F. J. Holler, S. R. Crouch, Principles of Instrumental

Analysis, 6th edition, California, Cengage Learning, 2006, ISBN: 0495012017.

CHEM 461 - Quantum Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 262 - Chemical Thermodynamics

Course content: The goal of this course is to understand the Basic principles of quantum chemistry, simple harmonic motion, the rigid rotor, atomic & molecular structure, solving the Schrödinger equation, a quantum mechanical model for the vibration and rotation of molecules, the Hydrogen atom and many –electron Atoms, quantum states for many –electron atoms and Huckel molecular orbital theory.

Reference textbooks: 1) K. J. Laidler, J. H. Meiser, and B. C. Sanctuary, Physical Chemistry, 4th edition, California, Cengage Learning, 2003, ISBN: 978-0-618-12341-4. 2) P. Atkins, J. De Paula, Atkins' Physical Chemistry, 10th edition, Oxford, Oxford University Press, 2014, ISBN: 978-0199697403. 3) T. Engel and P. Reid, Physical Chemistry, 2nd edition, New Jersey, Pearson Education Inc., 2010, ISBN: 0-321-64305-4.

CHEM 466 - Surface and Catalysis (2 credits: 2 h lecture)

Pre-requisite: CHEM 262 - Chemical Thermodynamics, *Co-requisite:* CHEM 368 - Chemical Kinetics

Course content: Part 1 (Surface Chemistry): The goal of this part is to understand the basic definitions of surface tension, the adsorption on surface, adsorption isotherms and important techniques for the characterization of surfaces. Part 2 (Catalysis): The goal of this part is to understand the basic definitions of catalysis, the types of catalysis and the catalysis cycle, characteristics of the catalytic reactions and catalytic materials and their applications.

Reference textbooks: 1) G. A. Somorjai and Y. Li, Introduction to Surface Chemistry and Catalysis, 2nd edition, New Jersey, Wiley, 2010, ISBN: 047050823X. 2) P. Atkins, J. De

Paula, Atkins' Physical Chemistry, 10th edition, Oxford, Oxford University Press, 2014, ISBN: 978-0199697403. 3) M. Bowker, The basis and applications of heterogeneous catalysis, Oxford, Oxford University Press, 1998, ISBN: 0198559585.

CHEM 467 - Practical Physical Chemistry II (2 credits: 6 h lab)

Pre-requisite: CHEM 368 - Chemical Kinetics, ***Co-requisite:*** CHEM 466 - Surface and Catalysis.

Course content: This lab course covers two parts: The first covers topics in chemical kinetics through twelve (12) experiments to determine specific rate constants and half-life time for 1st, pseudo-first, and 2nd order reactions, to determine order of simple reactions, to study the effect of catalysts on the rate of chemical reactions, to determine the activation energy by using Arrhenius equation at different temperatures, and to study the effect of ionic strength on rate of chemical reactions. The second covers various topics in surface chemistry and catalysis through twelve (12) experiments to determine surface tension and factors affecting it, to study the extent of adsorption on some adsorbents, to determine adsorption parameters and heat of adsorption, and to study the catalytic effect on some reactions.

Reference textbooks: 1) P. Atkins, J. De Paula, Atkins' Physical Chemistry, 10th edition, Oxford, Oxford University Press, 2014, ISBN: 978-0199697403. 2) C. W. Garland, J. W. Nibler, D. P. Shoemaker, Experiments in physical Chemistry, 8th edition, New York, McGraw-Hill, 2009, ISBN: 978-0-07-282842-9.

CHEM 470 - Heterocyclic Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 371 - Organic reaction Mechanism, CHEM 376 - Organic Spectroscopy

Course content: This course covers the systematic nomenclature of heterocycles, five and six membered rings with one heteroatom, i.e. pyrroles, furans, thiophenes, pyridines and

Their benzo derivatives. Synthesis, reactions, physical and chemical properties. Five and six membered rings with two heteroatom, i.e. diazoles, oxazoles, thiazoles diazines, oxazines, thiazines. Five and six membered rings with three and more heteroatoms: triazoles triazines, tetrazines, oxadiazines and oxathiazines.

Reference textbook: T. L. Gilchrist, Heterocyclic Chemistry, 3rd edition, New Jersey, Pearson Education Inc., 2007, ISBN: 0582278430.

CHEM 478 - Practical Organic Chemistry II (2 credits: 6 h lab)

Co-request: CHEM 470 - Heterocyclic Chemistry

Course content: The course emphasizes the practical of organic chemistry. Experiments include theoretical and experimental; Synthesis, separation, and calculation the theoretical yield and the percent yield for each compound synthesized. We characterized by measuring the melting point and the recrystallization.

Reference textbook: A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford, P.W.G. Smith, Textbook of practical organic chemistry, 5th edition, Pearson, 1996, ISBN: 978-0582462366.

CHEM 479 - Petrochemicals (2 credits: 2 h lecture)

Pre-requisite: CHEM 274 - Organic Chemistry II

Course content: To provide an overview of natural gas, oil importance, properties, its origin and structure, methods of petrochemical production, chemistry of industrial fibers, brief on local chemical industries, used technology in manufacturing polyethylenes, polystyrenes and PVC.

Reference textbook: U. R. Chaudhuri, Fundamentals of petroleum and petrochemical engineering, Boca Raton, CRC Press, 2011, ISBN: 1439851603.

CHEM 480 - Applied Inorganic Chemistry (2 credits: 1 h lecture, 3 h lab)

Pre-requisite: CHEM 385 - Coordination Chemistry

Course content: The Chemical Basis of Metallurgical Processes: extraction, purification and refinement of metals from their ores. Structure, chemical and physical properties of various inorganic materials, e.g., kaolins, zeolite, ceramics, fullerenes, glasses and metals.

Practical part: 12 experiments related to the theoretical topics.

Reference textbook: P. Atkins et al., Shriver and Atkins' Inorganic Chemistry, 5th edition, New York, W.H. Freeman. ISBN: 1429218207.

CHEM 483 - Nuclear and Radiation (2 credits: 2 h lecture)

Pre-requisite: CHEM 286 - Coordination Chemistry, CHEM 368 - Chemical Kinetics

Course content: An introduction to nuclear and radiochemistry stressing the fundamentals of nuclear structure, systematic of nuclear decay, the detection and measurement of radiation, radiation protection, and the role of nuclear chemistry in medical, environmental and scientific applications. The nuclear fuel cycle and nuclear waste problems.

Reference textbook: G. Choppin, J. Rydberg, and J-O Liljenzin, Radiochemistry and Nuclear Chemistry, 3rd edition, Oxford, Butterworth-Heinemann, 2001. ISBN: 0750674636.

CHEM 488 - Organometallic Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 385 - Coordination Chemistry

Course content: Properties of organometallic compounds (18 electron rule, metal-metal bonding). Chemical properties of different classes of organometallic compounds, including i. Metal Alkyls and Hydrides. ii. Metal Carbonyls and Phosphines iii. π (pi) ligands. Reactions of organometallics, including i. Oxidative Addition/Reductive

Elimination ii. Insertion/Elimination. Applications of organometallic chemistry, including (time permitting) i. Small molecule and C-H bond activation ii. Ethylene (and other olefin) polymerization iii. Organometallic materials and polymers iv. Organic Synthesis. Selected examples of organolanthanides and organoactinides (thorium and uranium).

Reference textbooks: C. Elschenbroich and A. Salzer, Organometallics: A concise Introduction, 2nd edition, Weinheim, Wiley VCH, ISBN: 3527281649.

CHEM 493 - Chromatographic Separation Methods (2 credits: 1 h lecture, 2 h lab)

Pre-requisite: CHEM 394 - Practical Instrumental Analysis

Course content: The goal of this course is to understand the theory and practice of the state of analytical and preparative chromatographic separation processes. The course focuses primarily on the theory of separation, analytical gas chromatography, analytical liquid chromatography and comparison of High-Performance Liquid Chromatography and Gas Chromatography.

Practical part: 12 experiments related to the theoretical subjects will illustrate the most important concepts of various chromatographic separation methods such as Paper chromatography, GC, HPLC, and others.

Reference textbooks: 1) J. C. Giddings, Unified Separation Science, New Jersey, Wiley, 1991, ISBN: 0-471-52089-6. 2) K. Robards, P. R. Haddad and P. E. Jackson, Principles and Practice of Modern Chromatographic Methods, Amsterdam, Elsevier, 2004, ISBN: 0-12-589570-4.

CHEM 495 - Applied Analytical Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 493 - Chromatographic Separation Methods

Course content: This course is an upgrade of the basic knowledge in analytical chemistry leading to a final understanding of modern analytical methods for the quantitative analysis of real samples. This course will include: Preparation and treatments of samples

for analysis, application of electro-analytical and spectroscopic methods on analysis of different environmental samples, and finally, the application of spectro-photometric and chromatographic methods on industrial samples and pharmaceutical preparations.

Reference textbooks: 1) F. W. Fifield and P. J. Haines, Environmental Analytical Chemistry, 2nd edition, New Jersey, Wiley, 2000, ISBN: 978-0-632-05383-4. 2) D. Lee and M. Webb, Pharmaceutical Analysis (Sheffield Analytical Chemistry), New Jersey, Wiley-Blackwell, 2003, ISBN: 0849328144. 3) L. A. Ohannesian and A. J Streeter, Handbook of Pharmaceutical Analysis, Boca Raton, CRC Press, 2001, ISBN: 9780824704629.

CHEM 497 - Research Project (3 credits: 6 h lab)

Pre-requisite: 100 Earned Credit Hours and Department Approval

Course content: This course will be designed to enable students to understand the construction of scientific database, literature survey and the main concepts of writing a scientific paper, moreover, it will allow students to conduct scientific research. The student study an academic research methodology with the supervisor within 4-6 weeks 6 hours lecture/ week, then applies the scientific research methodology for preparing scientific study under the supervision of a professor. Finally, the student introduces a final report written by a scientific methodology and a presentation on the subject.

Reference textbooks: 1) M. J. Katz, From Research to Manuscript A Guide to Scientific Writing, 2nd edition, Berlin, Springer, 2009, ISBN: 1-4020-4045-8. 2) S. Bailey, Academic Writing: A Handbook for international students, 3rd edition, London, Routledge, 2011, ISBN: 978-0-415-59580-3.

ELECTIVE CHEMISTRY COURSES FOR THE PROGRAM (10 HOURS)

CHEM 314 - Green Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 274 - Organic Chemistry II

Course content: The goal of this course is to understand the general concept of Green chemistry that modify or totally redesign chemical products and processes with the objective of minimizing wastes and the use or generation of particularly dangerous materials, study the difference between the environmental and green chemistry and the 12 principles of green chemistry and its applications. Learn how we can design Safer Chemicals and reactions. To develop the students' understanding of the twelve principles of Green Chemistry and its applications.

Reference textbook: S. E. Manahan, Green Chemistry, and the ten commandments of sustainability, 3rd edition, Columbia, ChemChar Research, 2011, ISBN: 978-0-615-43383-7.

CHEM 318 - Biochemistry II (2 credits: 2 h lecture)

Pre-requisite: CHEM 312 - Biochemistry

Course content: The goal of this course is to understand the following topics: The biosynthesis of lipids and steroids, structure and function of biological membranes, vitamins and their classification, hormones and mechanism of hormones actions, enzyme structures and functions, enzymes kinetics and mechanisms of enzymatic catalysis, and coenzymes dependent enzymes mechanisms.

Reference textbook: Laurence Moran, Robert Horton, Gray Scrimgeour, Marc Perry, David Rawn. Principles of Biochemistry, Fifth edition, Pearson Education, 2013, ISBN-10: 1292021748, ISBN-13: 978-1292021744.

CHEM 319 - Industrial Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 102 - General Chemistry II

Course content: In its first part, this course will introduce industrial chemistry, by defining chemical processes, and presenting some unit operations and unit processes. The main part of this course will describe and study some chemical processes, especially, employed in the metal extraction, and some manufacturing industries.

Reference Textbooks: 1) C. A. Heaton, An Introduction to Industrial Chemistry, 3rd edition, Berlin, Springer, 1996. ISBN: 978-0-7514-0272-8. 2) H. L. White, Introduction to Industrial Chemistry, New Jersey, Wiley, 1986, ISBN: 0-471-82657-X.

CHEM 369 - Physical Chemistry of Polymers (2 credits: 2 h lecture)

Pre-requisite: CHEM 262 - Chemical Thermodynamics, ***Co-requisite:*** CHEM 377 - Polymer Chemistry

Course content: The goal of this course is to understand concepts related to molecular weight of polymers; polymer thermodynamics; polymer transitions, polymer structure and property; and different technologies of polymer processing.

Reference textbooks: 1) P. C. Hiemenz and T. P. Lodge, Polymer Chemistry, 2nd edition, Boca Raton, CRC Press, 2007, ISBN: 1574447793. 2) Y. Gnanou and M. Fontanille, Organic and physical chemistry of polymers, New Jersey, Wiley, 2008, ISBN: 978-0-471-72543-5. 3) M. N. Subramanian, Basics of Polymers - Fabrication and Processing Technology, New York, Momentum Press, 2015, ISBN: 978-1-60650-582-3.

CHEM 381 - Symmetry and Point Group Theory (2 credits: 2 h lecture)

Pre-requisite: CHEM 387 - Sold State Chemistry

Course content: This course is a description of; symmetry operators and symmetry elements, Point groups, an introduction to character tables, infrared spectroscopy, chiral molecules and application of group theory in formation and interpretation of molecular orbitals.

Reference textbook: C. E. Houscroft and A. G. Sharpe, Inorganic Chemistry, 3rd edition, New Jersey, Pearson Education Inc., 2007, ISBN: 978-0-13-175553-6.

CHEM 395 - Water Treatment (2 credits: 2 h lecture)

Pre-requisite: CHEM 294 - Methods of Spectroscopic Analysis

Course content: This course provides an introduction to water operations and the basic skills and knowledge needed to advance in this industry. An introductory survey of the fundamental concepts of chemical and physico-chemical will be covered. The course will provide an overview of water treatment processes as well as terminology and equipment used.

Reference textbook: D. Hendrickes, Fundamentals of water treatment unit processes: Physical, chemical and biological, Boca Raton, CRC Press, 2011, ISBN: 978-1420061918.

CHEM 413 - Statistics for Chemists (2 credits: 2 h lecture)

Pre-requisite: MATH 101 - Calculus 1

Course content: This course outlines the use of the statistics encountered in Chemistry, and goes through the basic tools that will be used to approach statistical analysis in chemical measurement. It also demonstrates the use of these tools in Excel.

Reference textbooks: 1) D. A. Skoog, D. M. West, F. J. Holler and S.R. Crouch, Fundamental of Analytical Chemistry, 8th edition, California, Cengage Learning, 2004, ISBN: 0-534-41797-3. 2) D. Harvey, Modern Analytical Chemistry, New York, McGraw-Hill, 1999, ISBN: 0–07–237547–7.

CHEM 465 - Applied Physical Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 366 - Electrochemistry

Course content: The goal of this course is to cover new trends in applied Physical Chemistry such as applied electrochemistry, applied photochemistry, Applications of LASERS, and Application of catalysis.

Reference textbooks: 1) P. R. Roberge, Corrosion Engineering: Principles and practices, New York, McGraw-Hill, 2008, ISBN: 0-07-164087-8. 2) J. O'M. Bockris and A.K.N Reddy, Modern Electrochemistry: An introduction to interdisciplinary area, vol 2, Berlin, Springer, 1973, ISBN: 0306250020. 3) D. R. Crow, Principles and Applications of Electrochemistry, 4th edition, Boca Raton, CRC Press, 1994, ISBN: 9780748743780.

CHEM 468 - Colloid Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 262 - Chemical Thermodynamics, ***Co-requisite:*** CHEM 368 - Chemical Kinetics

Course content: The goal of this course is to understand colloids, their classification and preparation, kinetic properties, optical and electrokinetic properties, colloid stability and application of colloids.

Reference textbooks: 1) D. J. Shaw, Introduction to Colloid and Surface Chemistry, 4th edition, Oxford, Butterworth-Heinemann, 2003, ISBN 07506 11820. 2) Terence Cosgrove, Colloid Science: Principles, Methods and Applications, 2nd edition, New

Jersey, Wiley, 2010, ISBN: 9780750611824.

CHEM 473 - Natural Products (2 credits: 2 h lecture)

Pre-requisite: CHEM 274 - Organic Chemistry II

Course content: Chemistry of natural products deals mainly with the isolation, extraction, purification and identification of chemical constituents in plants and animal kingdom. Also, it is concerned with the elucidation of structures of unknown compounds using different chemical and physical techniques possible. It is important here, to have an idea about the procedure of extractions and the methods of separation as well as the methods of determination of structures used in natural products chemistry.

Reference textbook: S. V. Bhat, B. A. Nagasampagi, M. Sivakumar, Chemistry of Natural Products, Berlin, Springer, 2005, ISBN: 3-540-40669-7.

CHEM476 - Advance Organic Synthesis (2 credits: 2 h lecture)

Pre-requisite: CHEM 274 - Organic Chemistry II

Course content: Brief overview of the principles of organic synthesis (retro-synthetic analysis & selectivity). This is followed by a many ways of making each type of molecule starting with simple aromatic and aliphatic compounds with one functional group and progressing to molecules with many functional groups.

Reference textbook: S. Warren and P. Wyatt, Organic Synthesis: The Disconnection Approach, 2nd edition, New Jersey, Wiley, 2009, ISBN: 0470712368.

CHEM 487 - Bioinorganic Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 385 - Coordination Chemistry

Course content: This course will give an overview of biological inorganic chemistry and

focus on the uptake, transport and storage of metal ions, electron-transfer systems, oxygen transport/activation, nitrogen fixation, bioinorganic Chemistry in medicine, toxicity of inorganic systems.

Reference textbook: E. Ochiai, Bioinorganic Chemistry A Survey, Amsterdam, Elsevier, 2008, ISBN: 978-0-12-088756-9.

CHEM 489 - Cluster Chemistry (2 credits: 2 h lecture)

Pre-requisite: CHEM 385 - Coordination Chemistry

Course content: The occurrence of molecular clusters, like fullerene C60, constitutes a fundamental feature midway between the chemistry of isolated chemical compounds and that of the elements. Main features of the Cluster Chemistry of both main group and transition metal elements are treated. Highlighting aspects related to the synthesis, the structure, the special bonding and the reactivity of these species. Current Concepts in Modern Chemistry - Transition Metal Cluster Chemistry - Main Group-Transition Metal Mixed Clusters - Cluster Compounds of the Main Group Elements - Synthetic Analogues of the Active Sites of Iron-Sulfur Proteins will be covered.

Reference textbook: G. González-Moraga, Cluster Chemistry, Berlin, Springer, 1993, ISBN: 978-3-540-56470-6.

CHEM498 - Drug Analysis (2 credits: 2 h lecture)

Co-request: CHEM 493 - Chromatographic Separation Methods

Course content: The goal of this course is to describe the various drugs categories and pharmaceutical similarities, and to provide a general overview of the prevalent chemical principles, methods, and instrumentation involved in the analysis and preparation of drugs.

Reference textbooks: 1) D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Analytical Chemistry: An Introduction, 8th edition, California, Cengage Learning, 2007, ISBN: 0-534-41797-3. 2) D. A. Skoog, F. J. Holler, S. R. Crouch, Principles of Instrumental Analysis, 6th edition, California, Cengage Learning, 2006, ISBN: 0495012017.

Program Key Performance Indicators (KPIs)

The institution's regular assessment system is a continuous cycle where the programme quality improvement is integrated. The system involves specific evidence monitoring and independent analyses of a preselected and measurable set of indicators ensuring that the overall performance is consistent with well-known national benchmarks. Performance internal evaluation is conducted annually and at least once every five years for comprehensive programme review at the national level.

Chemistry program has 21 key performance indicators (KPIs), which include the 17 KPIs recommended by the National Center for Academic Accreditation and Assessment (NCAAA), March 2019. KPIs of electrical engineering programme at UOH and KPIs from the college of science at King Saud University are used as internal and external benchmarks, respectively.

Standard	Code	Key Performance Indicators	Description
-1- Program Management and Quality Assurance	**KPI-P-01**	Percentage of achieved indicators of the program operational plan objectives.	Percentage of performance indicators of the operational plan objectives of the program that achieved the targeted annual level tc the total number of indicators targeted for these objectives in the same year.
	KPI-P-02	The awareness and support of the teaching staff and administrators of the mission of the	Percentage of faculty and program staff who are aware program/institution's mission using a questionnaire / interview to the total number of faculty and staff.

		program/institution.	
-2- Teaching and Learning	**KPI-P-03**	Students' Evaluation of quality of learning experience in the program.	Average of overall rating of final year students for the quality of learning experience in the program on a five-point scale in an annual survey.
	KPI-P-04	Students' evaluation of the quality of the courses.	Average students overall rating for the quality of courses on a five-point scale in an annual survey.
	KPI-P-05	Completion rate.	Proportion of undergraduate students who completed the program in minimum time in each cohort.
	KPI-P-06	First-year students' retention rate.	Percentage of first-year undergraduate students who continue at the program the next year to the total number of first-year students in the same year.
	KPI-P-07	Students' performance in the professional and/or national examinations.	Percentage of students or graduates who were successful in the professional and / or national examinations, or their score average and median (if any).
	KPI-P-08	Graduates' employability and enrolment in postgraduate programs.	Percentage of graduates from the program who within a year of graduation were: a. employed b. enrolled in postgraduate programs during the first year of their graduation to the total number of

			graduates in the same year.
	KPI-P-09	Average number of students in the class.	Average number of students per class (in each teaching session/activity: lecture, small group, tutorial, laboratory or clinical session).
	KPI-P-10	Employers' evaluation of the program graduates proficiency.	Average of overall rating of employers for the proficiency of the program graduates on a five-point scale in an annual survey.
	KPI-P-11	Students' evaluation of the value and quality of field activities.	Percentage of students' satisfaction with the presence and quality of field activities during the semester and the academic year at the program / college / university.
-3- Students	**KPI-P-12**	Students' satisfaction with the offered services.	Average of students' satisfaction rate with the various services offered by the program (restaurants, transportation, sports facilities, academic advising, ...) on a five-point scale in an annual survey.
-4- Teaching Staff	**KPI-P-13**	Ratio of students to teaching staff.	Ratio of the total number of students to the total number of full-time and full-time equivalent teaching staff in the program.
	KPI-P-14	Percentage of teaching staff distribution.	Percentage of teaching staff distribution based on: a. Gender b. Branches c. Academic Ranking

	KPI-P-15	Proportion of teaching staff leaving the program.	Proportion of teaching staff leaving the program annually for reasons other than age retirement to the total number of teaching staff.
	KPI-P-16	Percentage of publications of faculty members.	Percentage of full-time faculty members who published at least one research during the year to total faculty members in the program.
	KPI-P-17	Rate of published research per faculty member.	The average number of refereed and/or published research per each faculty member during the year (total number of refereed and/or published research to the total number of full-time or equivalent faculty members during the year).
	KPI-P-18	Citations rate in refereed journals per faculty member.	The average number of citations in refereed journals from published research per faculty member in the program (total number of citations in refereed journals from published research for full-time or equivalent faculty members to the total research published).
	KPI-P-19	Relevance of the qualifications and experience of faculty members to the courses they teach.	Percentage of faculty members with qualifications and experience of the courses they are studying compared to the total number of courses offered during the academic year.
	KPI-P-20	The percentage of full-time teaching staff	Number of full-time faculty, other staff and administrators engaged in

		members and others of administrative staff that participate in community service activities.	a community service activity during the academic year compared to the total number of faculty, other staff and administrators.
-5- Learning Resources, Facilities, and Equipment	**KPI-P-21**	Satisfaction of beneficiaries with the learning resources.	Average of beneficiaries' satisfaction rate with the adequacy and diversity of learning resources (references, journals, databases… etc.) on a five-point scale in an annual survey.

Facilities

The Department of Chemistry is located in the College of Science building (Building No. 17 in the main campus and No. 14C in the Girls branch). The building houses the classrooms and instructional laboratories as well as the offices.

College of Science

Department of Chemistry

Classroom facilities

Classroom teaching has been radically transformed by innovative technologies. The classrooms in the college of science are equipped with Smart Board functionalities or projectors which allow teachers to connect and collaborate with students in the best way. However, classrooms are, also, equipped with a white board. Each classroom can accommodate 25 - 40 students.

Classroom
(with projector, smart board, whiteboard and internet connection)

Classroom
(with projector, whiteboard and internet connection)

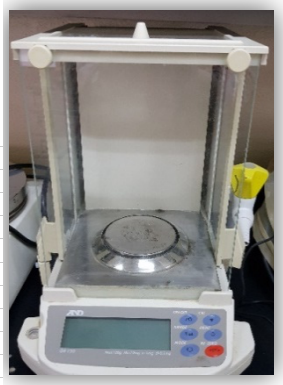
Laboratory facilities

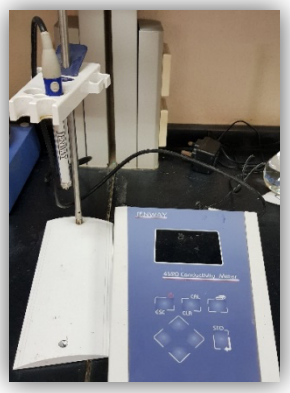
In chemistry department, we have instructional laboratories separately for each major field in chemistry, namely general chemistry, organic chemistry, inorganic chemistry, physical chemistry and analytical chemistry. Instructional laboratories, besides the research laboratories, are presenting a quantitative and qualitative leap for chemistry education in the college of science. The laboratories possess pre-lab lecture space and storage rooms offering top access for staff and all chemistry students. The labs are ready to host up to 25 students.

The labs are well equipped with the necessary lab technology and equipment providing a good interdisciplinary collaborative environment through a discreetly designed plan of adjacent lab-spaces. Some equipment in chemistry laboratories are:

- Water distiller
- P^H meter
- Magnetic stirrer
- Digital balance
- Analytical Balance
- Water bath
- Shaker
- Vortex
- Conduct meter
- Hotplate
- Hotplate stirrer
- Spectrophotometer
- Centrifuge
- Drying Oven

- Flame photometer
- Vacuum pump
- Rotary evaporator





In the chemistry laboratories, safety is the first priority. The chemistry laboratories are designed and equipped with required safety equipment.

Chemical Vapor Exhaust

Fume Hood

First Aid Box

Fire Alarm

Water Sprinkler

Fire Hose Reel

Fire Extinguisher

Emergency Shower

Eyewash system

Computer Facilities

The university offers personal Windows laptop computers for all staff. All the department members have the access to internet, printers, and copier. The deanship of information technology and e-learning maintains a continuous supply of both software and data, and maintaining these systems in function. The university offers WLAN services for both staff and students to access to their teaching and learning modules, respectively, and for students to access their academic registration, status, credit points achieved...etc., through the portal https://login.uoh.edu.sa. A specialized portal website for course information, learning materials, assignments, and electronic exams are accessed through the blackboard system; https://uoh.blackboard.com.

Library facilities

University central library, college library, and department library offer remarkable on-campus services. These libraries are providing students, faculty members, staff, and the community with collections of different book titles in different fields of Chemistry and others.

Department Library

Graduates employment opportunities

B.Sc. Chemistry program enable the graduated students to find the job as:

1. Chemist (211301)
2. Industrial Chemist (211302)
3. Petrochemical Industries Chemist (211304)
4. Biochemist (213102)
5. Environmental Specialist (213301)
6. Air Pollution Specialist (213302)
7. Water Quality Specialist (213303)
8. Secondary School Teacher of Chemistry (233011)
9. Intermediate School Teacher of Sciences (233034)
10. Chemical Plant Technician (311602)
11. Science Lab Technician (311907)
12. Chemical Processes Technician (313301)

The list of jobs was selected from the 'Saudi Standard Classification of Occupations' from the 'The Unified Saudi Occupational Classification' published by 'General Authority of Statistics, Saudi Arabia on 13/11/2019 (job code is mentioned in the bracket).