

COLLEGE OF SCIENCE

May 26, 2013

ACADEMIC DEPARTMENTS

The College of Science has five Academic Departments as given hereafter.

Academic Department	Degrees
Mathematical Sciences	<i>Bachelor of Science Degree in Mathematics</i>
Physics	<i>Bachelor of Science Degree in Physics</i>
Chemistry	<i>Bachelor of Science Degree in Chemistry</i> <i>Bachelor of Science Degree in Biochemistry</i>
Biology	<i>Bachelor of Science Degree in Biology (General Biology Concentration)</i> <i>Bachelor of Science Degree in Biology (Environmental Biology Concentration)</i> <i>Bachelor of Science Degree in Biology (Cellular and Molecular Biology Concentration)</i>
Geology	<i>Bachelor of Science Degree in Geology (Applied Geology Concentration)</i> <i>Bachelor of Science Degree in Geology (Petroleum Geology Concentration)</i>

GRADUATION REQUIREMENTS

A student must obtain 120 **Credit Hours** to graduate according to the following:

1. Common Requirements 30 - 36 Credit Hours depending on the major chosen.

The following common requirements apply to all students in the College:

1.1 University General Requirements **21 - 27 Credit Hours**

1.2 College Compulsory Requirements **9 Credit Hours**

Course No.	Course Title	Semester	Prerequisite	Credit Hours
ITBP 103	Principles of Information Technology	1&2	INTU 1420	3
MATH 105	Calculus 1	1&2	MATU 1435	3
PHYS 105	General Physics 1	1&2	MATU 1435	3

1.3 Free Elective Requirements **0-3 Credit Hours**

The student may select any course offered by the any of the Colleges to fulfill this requirement

2. Major specialization and supporting courses requirement: 75 to 87 Credit Hours, selected to fit the chosen major as set out in the specifications of each individual department.

Department of Chemistry

The department offers the degrees of Bachelor of Science in Chemistry as well as Bachelor of Science in Biochemistry. It also offers a minor in Chemistry for students of other departments. The BSc in Chemistry is a well-balanced curriculum that incorporates the modern fundamentals of the theoretical and practical aspects of analytical, inorganic, organic and physical chemistry is implemented to provide students with skills beyond their specialization. The BSc in Biochemistry degree is based on European and North American standards and offers an exciting curriculum that employs modern theoretical principles in the very diverse field of biochemistry. State-of-the-art laboratories provide up-to-date practical training that will prepare a student for exciting employment opportunities. Currently, 4 Professors, 10 Associate Professors and 7 Assistant Professors are affiliated with the department. The BSc Chemistry degree program is officially accredited by the Canadian Society for Chemistry as well as the Royal Society of Chemistry (UK).

Graduation Requirements (Bsc Degree In Chemistry)

1. Common Requirements

36 Credit Hours

(1.1) University General Education Courses 27 Credit Hours

(1.2) College compulsory requirements 9 Credit Hours

The details about the above common requirements are given above in the college related section.

2. Major specialization and supporting courses requirements:

75 Credit Hours

(2.1) Major Compulsory Requirements 42 Credit Hours

(2.2) Major Elective Requirements 3 Credit Hours

(2.3) Supporting Compulsory Requirements 12 Credit Hours

(2.4) Supporting Elective Requirements 18 Credit Hours

3. Internship

6 Credit Hours

4. Free elective course

3 Credit Hours

Total:

120 Credit Hours

First: BSc Degree in Chemistry Program:

A. Compulsory Major Specialization Requirements 42 Credit Hours

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 111	General Chemistry I	1&2	-	3
CHEM 112	General Chemistry II	1&2	CHEM 111	2
CHEM 115	General Chemistry Laboratory	1&2	CHEM 112*	1
CHEM 221	Analytical Chemistry	1&2	CHEM 112 + CHEM 115	3
CHEM 231	Inorganic Chemistry I	1&2	CHEM 251	3
CHEM 241	Organic Chemistry I	1&2	CHEM 111	3
CHEM 242	Organic Chemistry II	1&2	CHEM 241	3
CHEM 245	Organic Chemistry Laboratory I	1&2	CHEM 115+CHEM 241*	1
CHEM 251	Physical Chemistry I	1&2	CHEM 112 + MATH 105	3
CHEM 321	Instrumental Analysis	1&2	CHEM 221	4
CHEM 331	Inorganic Chemistry II (i)	1&2	CHEM 231	3
CHEM 337	Practical Inorganic Chemistry (i)	1&2	CHEM 331 +CHEM 321	1
CHEM 345	Organic Chemistry Laboratory II	1&2	CHEM 245	1
CHEM 351	Physical Chemistry II	1&2	CHEM 251	3
CHEM 355	Physical Chemistry Laboratory I (i)	1&2	CHEM 115+CHEM 351*	1
CHEM 356	Physical Chemistry Laboratory II	1&2	CHEM 355	1
CHEM 361	Biochemistry	1&2	CHEM 241*+CHEM 115	3
CHEM 418	Research Project	1&2	CHEM 356* + 337 + 345 + 361	3

* Concurrent

B. Elective Major Specialization Requirements:

3 Credit Hours

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 417	Advanced Laboratory Techniques	1&2	CHEM 356* + 337* + 345 + 361	1
CHEM 421	Instrumental Analysis II	1&2	CHEM321	2
CHEM 431	Inorganic Chemistry III	1&2	CHEM 331	2
CHEM 445	Spectroscopic Identification of Chemical Compounds (i)	1&2	CHEM 321 + 242 + 345	1
CHEM 451	Physical Chemistry III	1&2	CHEM 351 + MATH 110	2
CHEM 452	Electrochemistry	1&2	CHEM 251	2

(i) Concurrent with the Internship

C. Compulsory Supporting Requirements**12 Credit Hours**

Course No.	Course Title	Semester	Prerequisite	CH
MATH 110	Calculus II	1&2	MATH 105	3
PHYS 110	General Physics II	1&2	PHYS 105	3
BIOC 100	Basic Biology	1&2	-	3
ENG 310	Rhetoric and Composition 3B	1&2	-	3

D. Elective Supporting Requirements:**18 Credit Hours**

Upon the approval of the Department, a student may select to study a sequence of courses of a total of 18 Credit Hours constituting a specific **Minor**

Professional Internship Program**6 Credit Hours**

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 419	Internship	1&2	90 CH + GPA ≥ 2.00	6

4. Free Elective Requirements:**3 Credit Hours**

The student may select any course offered by the any of the Colleges to fulfill this requirement

Minor in Chemistry

The Department offers a **Minor** in Chemistry for the students of other Departments and Colleges.

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 111	General Chemistry I	1&2	-	3
CHEM 112	General Chemistry II	1&2	CHEM 111	2
CHEM 115	General Chemistry Laboratory	1&2	CHEM 112*	1
CHEM 221	Analytical Chemistry	1&2	CHEM 112 + CHEM 115	3
CHEM 231	Inorganic Chemistry I	1&2	CHEM 251	3
CHEM 241	Organic Chemistry I	1&2	CHEM 111	3
CHEM 242	Organic Chemistry II	1&2	CHEM 241	3
CHEM 245	Organic Chemistry Laboratory I	1&2	CHEM 115 + CHEM 241*	1
CHEM 251	Physical Chemistry I	1&2	CHEM 112 + MATH 105	3
CHEM 321	Instrumental Analysis I	1&2	CHEM 221	4
CHEM 331	Inorganic Chemistry II	1&2	CHEM 231	3
CHEM 345	Organic Chemistry Laboratory II	1&2	CHEM 245	1
CHEM 351	Physical Chemistry II	1&2	CHEM 251	3
CHEM 355	Physical Chemistry Laboratory I	1&2	CHEM 115 + CHEM 351	1
CHEM 361	Biochemistry	1&2	CHEM 241*+CHEM 115	3

* Concurrent

Second: BSc in Biochemistry degree Program

1. Common Requirements

36 Credit Hours

(1.1) University general requirements 27 Credit Hours

(1.2) College compulsory requirements 9 Credit Hours

The details about the above common requirements are given above in the college related section.

2. Major specialization and supporting courses requirement:

75Credit Hours

(2.1) Major Compulsory Requirements 45 Credit Hours

(2.2) Supporting Compulsory Requirements 12 Credit Hours

(2.3) Supporting Elective Requirements 18 Credit Hours

3. Internship

6 Credit Hours

4. Free elective course

3 Credit Hours

Total:

120 Credit Hours

A. Compulsory Major Specialization Requirements 45 Credit Hours

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 111	General Chemistry I	1 & 2	----	3
CHEM 112	General Chemistry II	1 & 2	CHEM 111	2
CHEM 115	General Chemistry Laboratory	1 & 2	CHEM 112*	1
CHEM 211	Professional and Trans. Skills for Chemists	1 & 2	CHEM 112	1
CHEM 221	Analytical Chemistry	1 & 2	CHEM 112 + CHEM 115	3
CHEM 231	Inorganic Chemistry I	1 & 2	CHEM 251	3
CHEM 241	Organic Chemistry I	1 & 2	CHEM 111	3
CHEM 242	Organic Chemistry II	1 & 2	CHEM 241	3
CHEM 245	Organic Chemistry Lab I	1 & 2	CHEM 115 + CHEM 241*	1
CHEM 251	Physical Chemistry I	1 & 2	CHEM 112 + MATH 105	3
CHEM 355	Physical Chemistry Lab I (i)	1 & 2	CHEM 115 + CHEM 251	1
CHEM 361	Biochemistry	1 & 2	CHEM 241* + CHEM 115	3
BCHM 362	Biochemistry II	1 & 2	BCHM 362	3
BCHM 345	Experimental Biochemistry (i)	1 & 2	BCHM 362	1
BCHM 471	Protein Structure and Function (i)	1 & 2	BCHM 362	2
BCHM 481	Special topics in Biochemistry I (Genomics, Proteomics and Signal Transduction) (i)	1 & 2	BCHM 362	2
BCHM 482	Special topics in Biochemistry II (Environmental and Biochemical Toxicology)	1 & 2	BCHM 362	2
BIOC 230	General Microbiology	1 & 2	BIOC 100	3
BIOL 270	Gen. Genetics	1 & 2	BIOC 100	2
BIOM 399	Molecular Biology	1 & 2	BIOL 270	2
BIOM 488	Molecular Biology Techniques	2	BIOL 270	1

(i) Concurrent with the Internship

B. Compulsory Supporting Requirements:

12 Credit Hours

Course No.	Course Title	Semester	Prerequisite	CH
BIOC 100	Basic Biology	1&2	-	3
ENG 310	Rhetoric and Composition 3B	1&2	-	3
MATH 110	Calculus II	1&2	MATH 105	3
PHYS 110	General Physics II	1&2	PHYS 105	3

C. Elective Supporting Requirements:

18 Credit Hours

Upon the approval of the Department, the student may select a total of 18 Credit Hours from a specific minor.

D. Professional Internship Program

6 Credit Hours

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 419	Internship	1&2	90 CH + GPA $\geq$ 2.00	6

Minor In Biochemistry

Biochemistry BSs students are also encouraged to take a minor (offered by other departments) by taking 18 CH of courses outside their major. However, biochemistry students are not allowed to get a minor in chemistry - likewise, chemistry students are not allowed to have a minor in biochemistry.

Students from other departments/colleges are encouraged to get a minor in biochemistry. A minor in biochemistry will provide students enough knowledge of chemistry, biochemistry, and biology to understand and appreciate the basics of biochemical reactions in living systems.

Requirements: A total of 18 **Credit Hours** comprising 'Group A' and 'Group B' courses, as listed below:

Group A: At least 6 Credit Hours from the courses listed below (Max. 8)

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 361	Biochemistry	1 & 2	CHEM 241(or concurrent) CHEM115	3
BCHM 362	Biochemistry II	1 & 2	CHEM 361	3
BCHM 345	Experimental Biochemistry	1 & 2	BCHM 362	1
BCHM 471	Protein Structure and Function	1 & 2	BCHM 362	2
BCHM 481	Special topics in Biochemistry I (Genomics, Proteomics and Signal Transduction)	1 & 2	BCHM 362	2
BCHM 482	Special topics in Biochemistry II (Environmental and Biochemical Toxicology)	1 & 2	BCHM 362	2

Group B: At least 10 Credit Hours from the courses listed below (Max. 12)

Course No.	Course Title	Semester	Prerequisite	CH
CHEM 111	General Chemistry I	1 & 2	----	3
CHEM 112	General Chemistry II	1 & 2	CHEM 111	2
CHEM 115	General Chemistry Laboratory*	1 & 2	CHEM 112*	1
CHEM 211	Prof. & Transferable skills for Chemists	1 & 2	CHEM 112	1
CHEM 221	Analytical Chemistry	1 & 2	CHEM 112 +115	3
CHEM 251	Physical Chemistry I	1 & 2	CHEM 112 & MATH 105	3
CHEM 231	Inorganic Chemistry I	1 & 2	CHEM 251	3
CHEM 241	Organic Chemistry I	1 & 2	CHEM 111	3
CHEM 242	Organic Chemistry II	1 & 2	CHEM 241	3
CHEM 245	Organic Chemistry Laboratory I	1 & 2	CHEM 115 & CHEM 241*	1
CHEM 321	Instrumental Analysis I	1 & 2	CHEM 221	4
CHEM 331	Inorganic Chemistry II	1 & 2	CHEM 231	3
CHEM 345	Organic Chemistry Laboratory II	1 & 2	CHEM 245	1
CHEM 351	Physical Chemistry II	1 & 2	CHEM 251	3
CHEM 355	Physical Chemistry Lab I	1 & 2	CHEM 115 & CHEM 351*	1

Courses Descriptions:

CHEM 111: General Chemistry I

3 Credit Hours (3+0)

Matter and measurement. Atoms, molecules and ions. Chemical stoichiometry. Acids-Bases and oxidation-reduction reactions. Oxidation numbers and the balancing of equations. The electronic structure of atoms and the periodic table of elements. Periodic properties of the elements. Basic concepts of chemical bonding and molecular geometry. Gases. Intermolecular forces. Solubility and Concentration units. **(Prerequisite: None)**

CHEM 112: General Chemistry II

2 Credit Hours (2+0)

Thermochemistry. Reactions in aqueous solutions. Gaseous equilibrium. Acids and bases. Ionic equilibria. Qualitative analysis. Electrochemistry. Rates of reactions. **(Prerequisite: CHEM 111)**

CHEM 115: General Chemistry Laboratory

1 Credit Hour(0+3)

Introduction to the elementary laboratory techniques. It includes principles of chemical calculations, techniques of qualitative analysis with special emphasis on applications of chemical equilibria. **(Prerequisite: CHEM 112 or concurrent)**

CHEM 221: Analytical Chemistry

3 Credit Hours (2+3)

This course deals primarily with non-instrumental techniques in quantitative chemical analysis. The topics covered include volumetric and gravimetric methods which based on solution equilibria such as acid-base, complexometric, redox and gravimetric reactions. The course also aims also to introduce students to the various types of errors in chemical analysis, kinetic methods of analysis and non-chromatographic separation methods. The associated laboratory experiments provide experience in applying these methods in chemical determinations. **(Prerequisite: CHEM 112 + CHEM 115)**

CHEM 231: Inorganic Chemistry I

3 Credit Hours (3+0)

This course involves topics in basic inorganic chemistry which cover the structure and bonding in molecules, the chemistry of the oxoanions and oxoacids, solvents, solutions, acids and bases and the chemistry of selected main group elements and their associated compounds. The course covers the following areas explicitly: the structure of atoms, atomic orbitals in wave mechanics; periodic properties of the elements; structure and bonding in molecules: introduction, molecular orbital theory: homo and heteronuclear diatomics, polyatomics, multicentre MO, electron-deficient molecules, π -donor and acceptor ligands; elements of symmetry, symmetry operations and point group symmetry determination; ionic solids: lattice and close-packing concepts, ionic radii, lattice energy calculations and correlation to properties solubility, hardness etc.; metallic substances: metallic bonding, band theory, conductivity, semiconductors, insulators, defects, preparation of new materials through doping, metallurgy; solvents, solutions, acids and bases; chemistry of the main-group elements. **(Prerequisite: CHEM 251)**

CHEM 241: Organic Chemistry I

3 Credit Hours (3+0)

Introduction to organic chemistry. Nomenclature, isomerism, sources, methods of preparation, physical properties, reactions and mechanisms of: alkanes, alkenes, alkynes, alicyclic hydrocarbons, alkyl halides, alcohols and ethers. Stereochemistry and optical activity. IR and UV-Vis spectroscopy. **(Prerequisite: CHEM 111)**

CHEM 242: Organic Chemistry II

3 Credit Hours (3+0)

Nomenclature, methods of preparation. Physical properties. Reactions and mechanisms of the following organic compounds: aldehydes, ketones, carboxylic acids, esters, amides, anhydrides and other acid derivatives and aromatic compounds. Introduction to carbohydrates, proteins and lipids. Introduction to NMR spectroscopy and mass spectrometry. **(Prerequisite: CHEM 241)**

CHEM 245: Organic Chemistry Laboratory I

1 Credit Hour(0+3)

Characterization of some organic compounds using physical and spectroscopic techniques, study of the chemical properties of some aliphatic and aromatic compounds containing functional groups. **(Prerequisite: CHEM 115 + CHEM 241 or concurrent)**

CHEM 251: Physical Chemistry I

3 Credit Hours (3+0)

The First law of thermodynamics. Thermo-chemistry, Second law of thermodynamics. Entropy and free energy. Third law of thermodynamics. Absolute zero. Chemical potential. Phase equilibria. Statistical thermodynamics. **(Prerequisite: CHEM 112 + MATH 105)**

CHEM 321: Instrumental Analysis I

4 Credit Hours (3+3)

This course aims primarily at developing the fundamental understanding of theory and applications of instrumental analytical techniques. The topics covered include spectrochemical, electrochemical and chromatographic techniques. The associated laboratory practical component provides extensive experience in applying these techniques to the chemical analysis of different samples. **(Prerequisite: CHEM 221)**

CHEM 331: Inorganic Chemistry II**3 Credit Hours (3+0)**

This course introduces the basic principles of coordination chemistry involving the following areas: introduction, chemical nomenclature, stereochemistry and isomerism of coordination compounds; theories of bonding in coordination compounds; the Jahn-Teller Effect; magnetic properties of transition metal complexes; electronic spectroscopy, term symbols and the spectrochemical series; thermodynamic aspects: formation constants, hydration enthalpies, ligand field stabilization energies, chelate effects; tautomerism, stereochemical nonrigidity and fluxionality; synthesis and types of reactions of complexes; lanthanides and actinides; mechanisms of inorganic reactions. **(Prerequisite: CHEM 231)**

CHEM 337: Practical Inorganic Chemistry**1 Credit Hour(0+3)**

This practical course covers the preparation and identification of a variety of main group and transition metallic compounds. The experiments include important inorganic synthetic techniques and methods of spectroscopic characterization. **(Prerequisite: CHEM 331 or concurrent + CHEM 321)**

CHEM 345: Organic Chemistry Laboratory II**1 Credit Hour(0+3)**

This experimental course covers multiple step syntheses of selected organic compounds and the characterization of their functional groups by spectroscopic analysis. **(Prerequisite: CHEM 245)**

CHEM 351: Physical Chemistry II**3 Credit Hours (3+0)**

This course covers two areas of physical chemistry, namely kinetics and quantum mechanics. The first part deals with chemical kinetics and the topics include the study of rate of chemical reactions and of the molecular processes by which the reaction occurs, differential and integral expressions with emphasis on multi-step as well as single-step first-order phenomena, expressing mechanisms in rate laws, consecutive elementary reactions, steady state approximation, reactions approaching equilibrium, collision theory, complex reactions, catalysis, photochemical reactions, molecular reaction dynamics, and diffusion controlled reactions. The second part deals quantum mechanics and the topics included are fundamental principles of quantum theory, such as Schrodinger equation, wave functions, quantum mechanical operators, quantum mechanics of a particle-in-a-box model. **(Prerequisite: CHEM 251)**

CHEM 355: Physical Chemistry Laboratory I**1 Credit Hour(0+3)**

The main objective of this course is to provide students with the necessary training on the use of modern techniques and instrumentation in thermodynamics, electrochemistry, kinetics and surface chemistry. **(Prerequisite: CHEM 115 + CHEM 351 concurrent)**

CHEM 356: Physical Chemistry Laboratory II**1 Credit Hour(0+3)**

This course involves experimental and computational techniques in physical chemistry. The course contents include: infrared and visible-ultraviolet spectroscopic experiments for chemical analysis, identification of molecular structure, determination of molecular geometry, and chemical kinetics; molecular modeling and simulations; computational chemistry, which includes quantum mechanical and semi-empirical methods. **(Prerequisite: CHEM 355)**

CHEM 361: Biochemistry**3 Credit Hours (2+3)**

Structure and chemical behavior of biochemical compounds, levels of protein structure, steady state enzyme kinetics and activities, fatty acid metabolism and lipoproteins utilization, phospholipids and membrane assembly, nucleotides and nucleic acids, amino acid metabolism, carbohydrate metabolism and intermediary regulation, bioenergetics and oxidative phosphorylation. The experimental component provides students with a range of techniques and methodology including sequential configuration, chromatography and electrophoresis for the isolation, separation and characterization of biomolecules; protein determination and enzyme activity assays. **(Prerequisite: CHEM 241 or concurrent + CHEM 115)**

CHEM 419: Internship**6 Credit Hours**

The student spends 8 weeks of training in an approved training site. **(Prerequisite: 90 CH + GPA $\geq$ 2.00)**

CHEM 417: Advanced Laboratory Techniques**1 Credit Hour(0+3)**

This course involves students getting some exposure to selected advanced chemical laboratory techniques across all domains of chemistry, involving a problem-based learning approach. **(Prerequisite: CHEM 356 or concurrent + CHEM 337 or concurrent + CHEM 345 + CHEM 361)**

CHEM 418: Research Project**3 Credit Hours (3+0)**

In this course, a student carries out a short research project under the academic supervision of a faculty member in the Department. The aim of the course is to provide students with an opportunity after a successful review of the chemical literature to apply their chemical knowledge and skills to an area of research without the restrictions of a planned practical. The student is expected to devote a set number of hours per week to research as discussed with his or her academic supervisor. At the end of the project, the student must submit a report on his/her research results, present a poster and give a short oral presentation based on the work. **(Prerequisite: CHEM 356 or concurrent + CHEM 337 + CHEM 345 + CHEM 361)**

CHEM 421: Instrumental Analysis II**2 Credit Hours (2+0)**

This theoretical course aims to introduce students to the general principles, basic instrumental aspects, and analytical applications of mass spectrometry, infra-red spectroscopy, nuclear magnetic resonance spectroscopy, atomic X-ray and hyphenated techniques. (Prerequisite: **CHEM321**)

CHEM 433: Inorganic Chemistry III**2 Credit Hours (2+0)**

This course covers the descriptive chemistry of main-group and transition metal elements and compounds synthesis, structures, properties, acid-base character, reactivities etc.. The course will cover selected main-group chemistry from the Periodic Table of Elements and selected elements and their associated complexes from the first-row transition metal d-block elements.

(Prerequisite: **CHEM 331**)

CHEM 445: Spectroscopic Identification of Chemical Compounds**1 Credit Hour(0+3)**

This practical course is designed to equip the student with basic strategies and techniques for the elucidation of molecular structure. It takes the students through a number of modern spectroscopic techniques mass spectrometry and infrared spectroscopy, nuclear magnetic resonance and ultraviolet/visible spectroscopy for the identification and quantification of chemical compounds. The emphasis is on practical applications. The course teaches the student what specific information can be obtained by each technique, proper sample preparation, proper instrumental use and interpretation of spectra. On successful completion of this course, the student will be able to select the most suitable spectroscopic methods to logically deduce the structures of unknown molecules. (Prerequisite: **CHEM 321 + CHEM 242 + CHEM 345**)

CHEM 451: Physical Chemistry III**2 Credit Hours (2+0)**

This course is a continuation of CHEM 351. It introduces quantum mechanical treatment of the harmonic oscillator and the rigid rotor models, quantum angular momentum, the hydrogen atom, multi-electron atoms, chemical bonding, and molecular orbital theory. (Prerequisite: **CHEM 351 + MATH 110**)

CHEM 452: Electrochemistry**2 Credit Hours (2+0)**

The course is intended to cover the principles of electrochemistry and its applications; topics such as ionic interaction, conducting properties of electrolytes, interfacial phenomena and double layer, thermodynamics and kinetics of electrochemical reactions and electrode processes and applications will be studied. (Prerequisite: **CHEM 251**)

Courses Offered to the other colleges:**CHEM 175: Chemistry Lab I for Eng.****1 Credit Hour (0+2)**

Chemistry Lab 1 for Engineering is an introduction to elementary laboratory techniques. It includes the principles of chemistry calculations, techniques of quantitative and qualitative analysis with special emphasis on engineering applications.

(Prerequisite: **CHEM 111 or concurrent**)

CHEM 181: Chemistry in the Modern World**3 Credit Hours (3+0)**

The role of chemistry in important issues of modern life is examined including the economic, social, health and ecological impact of chemistry. Chemical concepts are presented through examining various topics such as environment, ecology, nutrition and health. (Prerequisite: **None**)

CHEM 2702: General Chemistry and Engineering Applications II**3 Credit Hours (2+3)**

This course provides the students with an understanding of solutions, quantitative equilibria in aqueous solutions and gases, oxidation-reduction and electrochemistry, introduction to chemical kinetics, qualitative analysis, chemistry of metals and nonmetals, water chemistry, chemistry of the atmosphere, and engineering applications of these subjects.

(Prerequisite: **CHEM 111 + CHEM 175**)

CHEM 2703: Organic Chemistry and Engineering Applications I**3 Credit Hours (2+2)**

Types of bonding, hybridization of carbon. Naming, preparation in the laboratory and on an industrial scale, applications, chemical and physical properties of organic compounds: Aliphatic and aromatic hydrocarbons, alkyl halides, alcohols, thio alcohols, phenols, ethers, sulfides, aldehydes, ketones, carboxylic acids and derivatives, amines, polymers, structure/physical property relationships in organic chemistry. (Prerequisite: **CHEM 111 + CHEM 175**)

CHEM 2704: Organic Chemistry and Engineering Applications II**3 Credit Hours (2+2)**

This course is a continuation of Organic Chemistry and Engineering Application I. The course covers some key principles of modern organic chemistry: nomenclature, preparation, properties and reactions of aliphatic and aromatic compounds of carbon. There is considerable emphasis on molecular structure and the reactivity of organic molecules. Laboratory: Basic microscale techniques and synthetic procedures. (Prerequisite: **CHEM 2703**)

CHEM 2705: Physical Chemistry and Engineering Applications I**3 Credit Hours (2+2)**

The first law of thermodynamics. Thermochemistry. Second law of thermo-dynamics. Entropy. Free energy. Third law of thermodynamics. Absolute zero. Phase equilibria. Solutions. Chemical Equilibria. Electrochemistry. Attention will be focused on the underlying engineering applications. (Prerequisite: **CHEM 2702 or concurrent + CHEM 175**)

CHEM 3706: Physical Chemistry and Engineering Applications II**3 Credit Hours (2+2)**

Rates and orders of chemical reactions. Collision theory and Transition state theory. Physical properties of solid surfaces. Catalysis. Adsorption. Colloidal state and properties of colloids. Attention will be focused on the underlying engineering applications (Prerequisite: **CHEM 2705**)

CHEM 3707: Instrumental Analysis for Chemical Engineering**2 Credit Hours (1+2)**

The course deals with the fundamental concepts and applications of instrumental techniques in chemical analysis. The course covers some spectroscopic, electro-analytical, thermal, mass spectrometric and chromatographic methods of analysis. (Prerequisite: **CHEM 2702**)

CHEM 281: Analytical Chemistry for Non- Chemistry Students**3 Credit Hours (2+3)**

This course covers both classical and instrumental methods of chemical analysis. Titrimetric methods based on acid-base reactions, complex formation, precipitation, oxidation-reduction reactions are covered. Instrumental methods include spectrochemical, electrochemical and chromatographic techniques. The practical component includes experiments related to the above topics. (Prerequisite: **CHEM 111**)

CHEM 282: Organic Chemistry for Non-Chemistry Students**3 Credit Hours (2+3)**

Introduction to structure. Nomenclature. Physical properties. Preparation, reactions of hydrocarbons and functional groups containing organic compounds. The laboratory component includes the purification, isolation, characterization and study of the properties of typical organic compounds. (Prerequisite: **CHEM 111+ CHEM115**)

CHEM 283: Biochemistry for Non-Chemistry Students**3 Credit Hours (2+3)**

The chemical and physical properties of biological compounds. Theories of enzyme action and the factors affecting them. The practical component includes the isolation and study of biological properties of some biological compounds. (Prerequisite: **CHEM 282**)

Courses Offered To Students In B.Sc. In Biochemistry Degree Program:**CHEM 211: Professional and Transferable Skills for Chemists****1 Credit Hour (2+0)**

The aim of this course is to provide chemistry students with a wide range of generic, transferable skills, essential in and beyond the chemistry profession and to prepare students adequately for the Internship program and later professionally in the work-place. The course involves several different chemistry-specific components, including general study skills, communication skills both written and oral, critical-thinking exercises, group and project work, project management, time management and chemical information retrieval. Students are also given hands-on experience in tailored IT packages for chemistry, chemistry-specific computational programs, including chemical structure modeling etc. The module is delivered by Chemistry faculty through a combination of interactive active learning workshops, group work, presentations and hands-on sessions in the computer laboratory. (Prerequisite: **CHEM 112**)

BCHM 362 - Biochemistry II**3 Credit Hours (3+0)**

The aim of this course is to apply the basic knowledge gained in Biochemistry (CHEM 361) course to specific metabolic reactions and certain physiologically important biomolecules. The course covers regulation of enzymes (including blood clotting), mechanisms of transport through membranes, nucleic acid biotechnology, immunoglobulins and immunity (including cancer & virus), photosynthesis, metabolism of nitrogen, and biochemical communications. (including regulation of carbohydrate metabolism). (Prerequisite **CHEM 361**)

BCHM 345 - Experimental Biochemistry**1 Credit Hour (0+3)**

The aim of this course is to introduce basic biochemical laboratory techniques, with emphasis on protein biochemistry. The students will learn to use standard biochemistry lab instruments such as pH meters, spectrophotometers, pipettes, microplate readers. Standard protein purification and characterization techniques, enzyme activity assays, as well as immunoassays (ELISA) will also be taught. (Prerequisite **BCHM 362**)

BCHM 471 – Protein structure and Function**2 Credit Hours (2+0)**

The aim of this course is to study three principal aspects of proteins - physical properties, interaction with other biomolecules, and biochemical function - with an emphasis on levels of protein structure, folding conformation, biosynthesis, ribosome assembly, targeting, protein degradation, protein/DNA interactions and gene expression, membrane proteins and receptors, signal transduction, muscle action proteins. (Prerequisite **BCHM 362**)

BCHM 481 - Special Topics in Biochemistry I (Proteomics, Genomics & Signal Transduction)

2 Credit Hours (2+0)

This course aims to cover selected topics dealing with the recent advances in the field of genomics (genes related issues) and proteomics (protein related issues). The course will also discuss the current knowledge on cellular signal transduction, and link it with the actions of hormones, clinical biochemistry, as well as some types of cancer. Special attention will be paid to nuclear hormone receptor and G-protein coupled receptor signaling pathways. (Prerequisite BCHM 362)

BCHM 482 - Special Topics in Biochemistry II (Environmental & Biochemical Toxicology)

2 Credit Hours (2+0)

This course aims to cover selected topics that are not discussed in other courses that of current importance such as effects of environmental pollutants on biochemical metabolism, drug and antibiotic metabolism, antibodies and immunochemistry, biotransformation and detoxification. (Prerequisite BCHM 362)