FACULTY OF SCIENCES

FACULTY LIST

OFFICERS OF THE FACULTY

Salem, Elie A.	President of the University
Bashour, Tali'	Honorary Vice President for Medical Affairs in the USA
Karam, Nadim	Vice President for Health Affairs and Community Development
Nahas, George	Vice President for Planning and Educational Relations
Najjar, Michel	Vice President for Development, Administration and Public Relations
Attieh, Jihad	Dean
Moubayed, Walid	Dean of Admissions and Registration
Ayoub, Olga	Librarian

FACULTY STAFF

Abboud, Abdo	Laboratory Assistant
Aoun, Amal	Instructor
Attieh, Waed	Faculty Secretary
Bazzi, Samer	Research Assistant
Elias, Sally	Executive Secretary
Esber, Michella	Instructor
Habib, Joyce	Laboratory Assistant, Orientation Coordinator
Khatib, Salah	Laboratory Assistant
Khoury, Bilal	Research Assistant
Shikhani, Miguel	Laboratory Assistant
Moussa, Dima	Research Assistant
Nasr, Adele	Faculty Secretary
Ouaygen, Lama	Instructor
Saba, Jimmy	Instructor,LMS Administratior
Saliba, Chirine	Laboratory Assistant
Salman, Sara	Instructor
Zakhem, Michel	Instructor

FACULTY MEMBERS

Abbas, Abdel-Wahed	Ph.D., Computer Science, Queen Mary College, University of London, U.K.
Abdel-Massih, Roula	Ph.D., Biochemistry, University of Glasgow, UK.
Abdul-Aziz, Abdul-Rahman	Ph.D., Mathematics, University of Sydney, Australia.
Achkar (El), Eliane	Ph.D., Molecular Genetics, Université Paris VI, Pierre & Marie Curie, France.
Aouad, Samer	Ph.D., Physical Chemistry, Université du Littoral Côte d'Opale, France.
Atie, Elie	Ph.D., Physics Université de Franche-Comté, France.

Attieh, Jihad	Ph.D., Plant Physiology & Biochemistry, Université de Montréal, Canada.
Bassil, Bassem	Ph.D., Chemistry, Jacobs University, Germany
Bitar, Amine	Ph.D., Computer Science, University of Bedford, U.K.
Chami, Riad	M.S., Computer Science, University of Technology, Australia.
Dergham, Joumana	Ph.D., Computer Science, Université de Montréal, Canada.
Debs, Esperance	Ph.D., Food Processing, Université de La Rochelle, France.
Debs, Hamid	Ph.D., Biomedical Engineering, Université de Technologie de Compiègne, France.
Dib Nehme, Micheline	M.S., Mathematics, University of Texas-Arlington, U.S.A.
Dib, Youssef	Ph.D., Mathematics, University of Louisiana at Lafayette, U.S.A.
Echtay, Karim	Ph.D., Biochemistry, Ludwig Maximillians University, Germany.
Farah, Farah	Ph.D., Mathematics, Université Savoie, France.
Greije, Hanna	Ph.D., Statistical Mathematics, Université Pierre et Marie Curie, France.
Habib, Lamice	Ph.D., Biochemistry, Université Claude Bernard Lyon, France.
Haddad Samir	Ph.D., Networking Systems Universitéd'Evry Val d'Essonne, France.
Hanna, Robert	Emeritus Professor, Chemistry.
Hitti, Karim	Ph.D., Applied Mathematics, Ecole des Mines de Paris, France.
Issa, Carmen	M.S., Computer Science, University of Balamand, Lebanon.
Jadayel, Roula	M.S., Mathematics, American University of Beirut, Lebanon.
Jourdi, Houssam	Ph.D., Medical Sciences, Niigata University, Japan.
Jreige, Jocelyne	M.Sc., Computer Science, University of Balamand, Lebanon.
Karam, Marc	Ph.D., Biology, Surrey University, UK.
Kassab, Rima	Ph.D., Organic Chemistry, Université Claude-Bernard, France.
Kfoury, Adib	Ph.D., Atmospheric Chemistry, Université du Littoral Côte d'Opale, France.
Khoury, Takla	Ph.D., Cell Biology Université Grenoble Alpes, France
Melki, Antoine	Ph.D., Computer Science, University of Patras, Greece.

Mir (Al), Ghina	Ph.D., Mathematics, Université de La Rochelle, France.
Mitri, George	Ph.D., Forest Management, University of Trieste, Italy.
Nader, Manal	Ph.D., Biology and Aquaculture, Hokkaido University, Japan.
Nakat (El), Hanna	Ph.D., Physical Chemistry, University of New South Wales, Australia.
Nasr, Zeina	Ph.D., Biochemistry, McGill University, Canada.
Nicolas, Sameera	M.Sc., Computer Science, Georges Washington University, U.S.A.
Obeid, Pierre	Ph.D., Chemistry, University of Patras, Greece.
Rastikian, Karabet	Ph.D., Chemical Engineering, Université de Technologie de Compiègne, France.
Sabat, Mira	Ph.D, Mathematics, Université de Strasbourg, France.
Tannous, Tony	Ph.D., Science, University of Sydney, Australia.
Yaacoub, Guitta	D.E.A., Plant Production, Lebanese University, Lebanon.
Yammine, Paolo	Ph.D., Organic Chemistry, Université Paris XIII, France.
Zakhem, Imad	Ph.D., Computer Science, Université de Reims Champagne-Ardenne, France.

PROGRAMS OF STUDY

The Faculty of Sciences includes the following departments:

- Biology
- Chemistry
- Computer Science
- Environmental Sciences
- Mathematics
- Physics

The sequence of study proceeds from an education in both science fundamentals and humanities toward training designed to lead to the student's mastery of principles and arts central to science. The Faculty of Sciences offers the following undergraduate degrees:

Major	**Years**	**Degree**
Biology	3	BS
	3+1	Teaching Diploma
Chemistry	3	BS
	3+1	Teaching Diploma
Computer Science (Information Systems, Software Engineering)	3	BS
	3+1	Teaching Diploma
Environmental Sciences	3	BS
Mathematics	3	BS
	3+1	Teaching Diploma
Physics	3	BS
	3+1	Teaching Diploma

UNDERGRADUATE PROGRAM

1. ADMISSION REQUIREMENTS

Refer to General Section.

2. ACADEMIC RULES AND REGULATIONS

Refer to General Section.

A. CHANGE OF MAJOR

To change a current major within the Faculty of Sciences or to transfer from any other Faculty of the University of Balamand to the Faculty of Sciences, a student must qualify for a clear standing status in the new department. Probationary acceptance may be granted to transferring students, who do not satisfy the above condition, upon the recommendation of the new department and approval of the Dean.

B. CREDIT LOAD

The full-time load ranges between 12 and 18 credits, with a recommended average of 15-16 credits per regular semester. A higher credit load is only considered under special circumstances (e.g. graduation) and requires the approval of the Dean. A maximum of 10 credits is acceptable for the Summer semester.

C. REGISTRATION IN GRADUATE COURSES

Undergraduate students enrolled in their final semester may register for up to two graduate courses if judged appropriate by the Department and approved by the Dean. Grades of such courses do not count towards their undergraduate average. Enrollment in graduate courses does not imply in any way an automatic admission to the corresponding Master program.

3. LABORATORY CHARGES

A. SUPPLIES

Each student taking laboratory subjects must furnish the necessary notebooks, blank forms, lab coat, and similar supplies at his/her expense. For regular students taking prescribed laboratory work, no charge will be made for normal amounts of expendable material used in connection with the laboratory subject. Expendable materials are those that are necessarily consumed or rendered unfit for further use by the normal conduct of a laboratory test. If an excessive amount of expendable material is required because of carelessness on the part of the student, the cost of the additional material will be charged to the student or group responsible.

B. DAMAGES

Students will be charged for damage to instruments caused by neglect. The amount of the charge will be the actual cost of repair, and if the damage results in total loss of the apparatus, adjustment will be made in light of the condition of the instruments. Where there is danger of costly damage, an instructor should be requested to

check the equipment's set up. When a group does laboratory work, charges for breakage will be divided among the members of the group concerned. The amount of the charge will be stated immediately or as soon as it can be determined.

4. SUPPORT LABORATORIES

The laboratories that students will attend in support of the theoretical subjects include:

- Biology Labs.
- Chemistry Labs.
- Database Lab.
- Mathematics & Statistics Lab.
- Mobile Lab.
- Networking Lab.
- Physics Lab.
- Open Source Software Lab.

DEPARTMENT OF BIOLOGY

UNDERGRADUATE PROGRAM

The primary mandate of the Department of Biology is to provide excellence in teaching at the undergraduate and graduate levels. The Department offers a comprehensive program, which exposes students to the full range of biological sciences. Our undergraduate three-year curriculum introduces students to modern studies in general, molecular, cell, and environmental biology. It also emphasizes active, hands-on experience with modern technology. Small class sizes with an emphasis on laboratories and tutorials foster ongoing, productive interactions between students and faculty.

Program Learning Objectives

1.Introduce students to modern studies in general, molecular, cell, organ systems and environmental biology
2.Emphasize active, hands-on experience with modern technology
3.Prepare the students to go on to professional programs in medicine, pharmacy, medical sciences, biotechnology, or science education
4.Prepare students to enter the workforce directly, as research assistants, data analysts, teachers of science and members of marketing teams in the pharmaceutical and health industries
5.Equip students with theoretical and practical knowledge to pursue graduate studies in biological sciences, with the aim of following a career in academia or industry.

Program Learning Outcomes

By the time that undergraduate students receive their degree from our programs, they will:

1. Have gained sufficient understanding of the different biological facts and concepts

2. Have acquired knowledge on the most updated findings in different biology fields of study

3. Be able to think logically, communicate clearly and criticize their acquired biological knowledge and experimental skills

4. Be able to use scientific instrumentation and information technology and have acquired written, oral, and multimedia scientific communication skills

5. Be able to exert their acquired technical skills to successfully perform basic research techniques

6. Have acquired enough knowledge and skills to join and excel in professional programs in medicine, pharmacy, medical sciences, biotechnology and science education

7. Be outstanding members of the workforce by having adequate skills to retrieve, evaluate and communicate information from the scientific literature, electronic databases, and experimental data

8. Have enough skills to formulate and evaluate experimental research models based on observations of biological phenomena and apply quantitative methods to solve biological problems.

The Department of Biology offers a Bachelor of Science Degree (B.Sc.) in Biology for students who have successfully undertaken a minimum of **97 credits** of required courses provided that they satisfy all other graduation requirements set by the University.

Students must complete the following:

I. 44 credits of Major Courses

Thirty three credits (33 cr) constituted of the following courses: BIOL 201, 202, 203, 204, 207, 213, 214, 245, 246, 251, 261, 262, 283, 284, 285.

Plus eleven credits (11 cr) selected from: BIOL 208, 221, 222, 223, 224, 225, 226, 227, 229, 230, 231, 232, 233, 235, 236, 241, 242, 243, 244, 247, 249, 263, 264, 265, 266, 271, 272, 286, 287, 291, 292, 293, 294.

II. 22 credits of Major-Required Courses

CHEM 202, 203, 240*, 245, CSIS 273, MATH 242, PHYS 211, 212, 213, 214

***Premedical students normaly replace** CHEM 240 **with** CHEM 242 **&** CHEM 244**.**

III. 19 credits of University-Required Courses

ENGL 203, 204, a selection of 4 CSPR courses, LISP 200.

IV. 12 credits of Free Electives**

****A Premedical Student, having substituted CHEM 240 with CHEM 242 & CHEM 244 (6 cr), also takes CHEM 222 (Analytical Chemistry) or an equivalent course as an elective. Such student may only choose 6 credits as free electives.**

MINOR IN BIOLOGY

The minor in Biology allows students to gain valuable information in the field of biological sciences while completing their primary field of study. It also allows students to take advanced Biology coursework related to the main discipline. The Faculty of Sciences offers a Minor in Biology for students who have successfully completed a minimum of **18** credits of Biology courses as follows:

Code	Course Title	Credit
BIOL 201	General Biology I	3
BIOL 202	General Biology I Lab.	1
BIOL 203	General Biology II	3
BIOL 204	General Biology II Lab.	1

Any three courses (9 credits) and one lab (1 credit) picked from the following list*:

Code	Course Title	Credit
BIOL 207	Ecology	3
BIOL 208	Ecology Lab	1
BIOL 213	Cell Biology	3
BIOL 214	Cell Biology Lab	1
BIOL 225	Animal Physiology	3
BIOL 226	Animal Physiology Lab	1
BIOL 227	Neurophysiology	3
BIOL 229	Immunobiology	3
BIOL 233	Endocrinology	3
BIOL 235	Reproductive Biology & In Vitro Fertilization	3
BIOL 236	Reproductive Biology & In Vitro Fertilization Lab	1
BIOL 245	Plant Physiology	3
BIOL 246	Plant Physiology Lab	1
BIOL 251	Principles of Biochemistry	3
BIOL 261	Microbiology	3
BIOL 262	Microbiology Lab	1
BIOL 263	Nutrition	3
BIOL 264	Nutrition Lab	1
BIOL 283	Genetics	3

BIOL 284	Genetics Lab	1
BIOL 285	Molecular Biology	3
BIOL 286	Molecular Biology Lab	1
BIOL 287	Biotechnology & Recombinant DNA	3
BIOL 291	Special Topics in Biology	3
BIOL 292	Seminars in Biology	1
BIOL 293	Bioethics	1
BIOL 294	Training in Fertility Unit	2

* If carefully chosen, these courses may present a minor with a specific concentration.

BACHELOR'S DEGREE

SEMESTER 1

Course Code	Course Title	Credit
BIOL 201	General Biology I	3
BIOL 202	General Biology I Lab.	1
CHEM 202	Basic Chemistry	3
CHEM 203	Basic Chemistry Lab.	1
CSIS 273	Personal Computing for Applied Sciences	3
ENGL 203	English Communication Skills III	3
LISP 200	Library Use and Research Methods*	1
Total		**15**

SEMESTER 2

Course Code	Course Title	Credit
BIOL 203	General Biology II	3
BIOL 204	General Biology II Lab.	1
CHEM 240	Basic Organic Chemistry**	3
ENGL 204	English Communication Skills IV	3
MATH 242	Statistics for Applied Sciences	3
PHYS 211	Fundamentals of Physics I	3
PHYS 212	Fundamentals of Physics I Lab.	1
Total		**17**

SEMESTER 3

Course Code	Course Title	Credit
BIOL 283	Genetics	3
BIOL 284	Genetics Lab.	1
CHEM 245	Organic Chemistry Lab I.	1
CSPR 201	Civilization and Relegion	3
PHYS 213	Fundamentals of Physics II	3
PHYS 214	Fundamentals of Physics II Lab.	1
	Free Elective	3
Total		**15**

SEMESTER 4

Course Code	Course Title	Credit
BIOL 213	Cell Biology	3
BIOL 214	Cell Biology Lab.	1
BIOL 251	Principles of Biochemistry	3
CSPR 202	Philosophy and Culture	3
BIOL 285	Molecular Biology	3
	Major Elective	3
Total		**16**

SEMESTER 5

Course Code	Course Title	Credit
BIOL 207	General Ecology	3
BIOL 261	Microbiology	3
BIOL 262	Microbiology Lab.	1
CSPR 203	Cultures and Society	3
	Major Elective	3
	Major Elective Lab.	1
	Free Elective	3
Total		**17**

SEMESTER 6

Course Code	Course Title	Credit
BIOL 245	Plant Physiology	3
BIOL 246	Plant Physiology Lab.	1
CSPR 204	Arabic Throught and Culture	3
	Major Elective	3
	Major Elective Lab.	1
	Free Elective	3
	Free Elective	3
Total		**17**

Total credits **97**

*** This is a free-of-charge University-Required course.**
****A Premedical student may replace CHEM 240 with CHEM 242 & CHEM 244 (6 cr).**

Electives in the Department of Biology

Code	Course Title	Credit
BIOL 208	General Ecology Lab*	1
BIOL 221	Zoology	3
BIOL 222	Zoology Lab	1
BIOL 223	Comparative Vertebrate Anatomy	3
BIOL 224	Comparative Vertebrate Anatomy Lab	1
BIOL 225	Animal Physiology*	3
BIOL 226	Animal Physiology Lab*	1
BIOL 227	Neurophysiology*	3
BIOL 229	Immunobiology*	3
BIOL 230	Immunobiology Lab	1
BIOL 231	Developmental Biology*	3
BIOL 232	Developmental Biology Lab	1
BIOL 233	Endocrinology*	3
BIOL 235	Reproductive Biology & In Vitro Fertilization	3
BIOL 236	Reproductive Biology & In Vitro Fertilization Lab	1
BIOL 241	Botany	3
BIOL 242	Botany Lab	1
BIOL 243	Plant Anatomy	3
BIOL 244	Plant Anatomy Lab	1
BIOL 247	Economic Plant Biology	3
BIOL 249	Plant Secondary Metabolism	3
BIOL 263	Nutrition*	3
BIOL 264	Nutrition Lab	1
BIOL 265	Parasitology & Virology	3
BIOL 266	Parasitology & Virology Lab	1
BIOL 271	Principles of Soil Science	3
BIOL 272	Principles of Soil Science Lab	1
BIOL 286	Molecular Biology Lab*	1
BIOL 287	Biotechnology & Recombinant DNA*	3
BIOL 291	Special Topics in Biology	3
BIOL 292	Seminars in Biology*	1
BIOL 293	Bioethics	1
BIOL 294	Training in Fertility Unit	2

* Electives in Biology that are offered presently.

Concentration: Reproductive Biology / Embryology

The Departement of Biology offers within its Bachelor degree (B.Sc) a concentration in “Reproductive Biology”. This option allows Biology students to take specialized courses in Developmental, Reproductive, and Molecular Biology. It also emphasizes hands-on experience within the hospital fertility center, allowing them to develop a concentration in Assisted Procreation. This degree option is earned through the completion of the following courses within the general 97 cr. required for B.Sc. degree in Biology.

Code	Course Title	Credit
BIOL 225	Animal Physiology	3
BIOL 226	Animal Physiology Laboratory***	1
BIOL 231	Developmental Biology	3
BILO 235	Reproductive Biology & in vitro Fertilization	3
BIOL 236	Reproductive Biology & in vitro Fertilization Lab	1
BIOL 293	Bioethics	1
BIOL 294	Training in Fertility Unit	2

***This credit may also be earned either by covering BIOL 224 (Comparative Vertebrate Anatomy Laboratory), BIOL 286 (Molecular Biology Laboratory), BIOL 236 (Reproductive Biology & In Vitro FertilizationLaboratory), BIOL 232 (Developmental Biology Laboratory) or BIOL 292 (Seminars in Biology).

COURSE DESCRIPTIONS

BIOL 101 INTRODUCTION TO BIOLOGY I **3.0: 3 cr. E**

This course is an introduction to the basic concepts of Genetics and Evolution, for students undertaking the Freshman Program.

BIOL 102 INTRODUCTION TO BIOLOGY I LABORATORY **0.3: 1 cr. E**

A set of experiments that introduce students to the world of Biology, including use of the microscope, introduction to DNA isolation and manipulation, and the safe use of biology lab equipment.

BIOL 103 INTRODUCTION TO BIOLOGY II **3.0: 3 cr. E**

This course is an introduction to the basic concepts of evaluation, ecology and the origin and classification of life. The course focuses on population genetics and ecology with an emphasis on interactions among communities and aspect of behavior. The course also discusses the classification of organisisms ranging from Bacteria, Archaea to plants and animals.

BIOL 104 INTRODUCTION TO BIOLOGY II LABORATORY **0.3: 1 cr. E**

A set of experiments that introduce students to metabolism, including anatomy of the nervous system, neurophysiology, testing for glycaemia, blood cells, blood typing, and an introduction to immunological techniques.

Pre-requisite: BIOL 102.

BIOL 201 GENERAL BIOLOGY I **3.0: 3 cr. E**

Basic aspects of cell structure, heredity, diversity, classification, evolution,and energy transfer through living organisims.

BIOL 202 GENERAL BIOLOGY I LABORATORY **0.3: 1 cr. E**

This is the first direct encounter of students with the concrete world of biology. Experiments will cover the subjects and theories introduced in course work. The student will then acquire a working knowledge of biology, and will be familiar with much of the overall aspects of our surrounding environment. In a laboratory framework, many details of the biological world will be explored and thus will become clearer and better understood.

BIOL 203 GENERAL BIOLOGY II **3.0: 3 cr. E**

General Biology II is designed to complement the information learned in General Biology I. BIOL 203 is intended to biology majors, pre-health professionals, or those needing an in-depth biology sequence. The course is designed to give a general overview of structure and life process in animals. Presented with an evolutionary perspective, representative organisms of the various classes are examined with a comparative and dissecting eye, through which the animal body is discovered. The course strongly emphasizes comparative animal physiology, showing the structural, functional, and behavioral adaptations that help animals meet environnmental challenges. A comparative approach is used to examine how various animal groups have solved similar and diverse problems.

BIOL 204 GENERAL BIOLOGY II LABORATORY **0.3: 1 cr. E**

General Biology II Laboratory is an active learning experience about different types of tissues and organs in the animal kingdom. Experiments will cover the subjects and theories introduced in course work. Details of the biological world, particularly those aspects which cannot be seen with the unaided eye, remainto be understood, and explored. The way of knowledge acquisition suggested in each session enables students not only to be active recipients to information but will also develop their scientific skills in biology through the performance of observing, inquiring, and reporting about living things.

BIOL 205 PRINCIPLES OF HUMAN BIOLOGY **3.0: 3 cr. E**

Principles of Human Biology is designed to provide a basic overview of human biology, starting from the most elementary fabrics of life and moving up to the organ systems that make the sophisticated living marvel, the human body. The material of this course is intended to those who are in need of an encompassing view of the human body without necessarily going into the fine details that govern the functions of cells, organs and organ systems. This is an ideal bridging course for individuals coming from all backgrounds. This course is not offered to students majoring in Biology and cannot be counted as a Premedical course.

BIOL 207 GENERAL ECOLOGY **3.0: 3 cr. E**

Origin and evolution of the biosphere, introduction to climates, ecosystems and biomes. A study of the interrelations of organisms and their environments. Principles of growth, regulation, distribution, structure and energetics of populations and communities are explored.

Co-requisite: BIOL 203.

BIOL 208 GENERAL ECOLOGY LABORATORY **0.3: 1 cr. E**

Field and laboratory exercises illustrating concepts of general ecology.

Co-requisite: BIOL 207.

BIOL 213 CELL BIOLOGY **3.0: 3 cr. E**

A general description of the structure and function of cellular organelles and cell components, with emphasis on the cellular sorting, signaling and interactions between cells and their environment.

Pre-requisite: BIOL 203.

BIOL 214 CELL BIOLOGY LABORATORY **0.3: 1 cr. E**

Laboratory experiments include structure/function relationship in cell organelles. Introduction to basic techniques used in the field of cell biology.

Co-requisite: BIOL 213.

BIOL 221 ZOOLOGY **3.0: 3 cr. E**

A general introduction to protists and animals without backbones. Emphasis placed on evolutionary and ecological relationships that make an understanding and appreciation of this diverse group of animals possible. A study of the vertebrates with regard to their systematics, ecology, and behavior.

Pre-requisite: BIOL 203.

BIOL 222 ZOOLOGY LABORATORY **0.3: 1 cr. E**

Exercises designed to introduce students to the 95 percent of all animals without a backbone. Identification of representative vertebrates through examination of specimens.

Co-requisite: BIOL 221.

BIOL 223 COMPARATIVE VERTEBRATE ANATOMY **3.0: 3 cr. E**

A comparative study of the functional adaptations, which caused structural changes in different chordate animals with special emphasis on the human anatomy.

Pre-requisite: BIOL 203.

BIOL 224 COMPARATIVE VERTEBRATE ANATOMY LABORATORY 0.3: 1 cr. E

A practical comparison of the anatomy of different vertebrates ranging from simplest forms to the most complex especially human.

Co-requisite: BIOL 223.

BIOL 225 ANIMAL PHYSIOLOGY 3.0: 3 cr. E

A study of the functions of living things with emphasis on the chemical and physical properties of protoplasm, the conversion of energy and matter through cell respiration and synthesis, the transport of materials across membranes, cell excitability and contraction, and regulatory processes. A comparative study of physiological systems; nutrition, circulation, respiration, osmoregulation and excretion, nervous and endocrine coordination.
Pre-requisite: BIOL 203

BIOL 226 ANIMAL PHYSIOLOGY LABORATORY 0.3: 1 cr. E

Experimental investigation of various functions of cells by isolation and characterization of subcellular parts and examination of cellular processes such as membrane transport and cell excitability. Experimental examination of the various vertebrate organ systems and how different animals deal with physiological problems.

Co-requisite: BIOL 225.

BIOL 227 NEUROPHYSIOLOGY 3.0: 3 cr. E

An introduction to the nervous system with an organizational study of neural functions from molecular to organ level. Study of the biochemical and physiological process in the brain and the basics of various neurological disorders.

Pre-requisite: BIOL 213.

BIOL 229 IMMUNOBIOLOGY 3.0: 3 cr. E

Provides basic knowledge of the immune response and its involvement in health and disease. Introductory concepts of immunity, structure and function of the immune system, antigens and antibodies, complement, genetic basis of the immune response, humoral and cellular immunity, immunological tolerence, organ and tissue transplantation, allergy and autoimmunity.

Pre-requisite: BIOL 213

BIOL 230 IMMUNOBIOLOGY LABORATORY 0.3: 1 cr. E

This course discusses subjects related to the mammalian immune system along with the application of various techniques used in the field of immunology such as leukocyte count, western blotting, immunoprecipitation, and ELISA.

Co-requisite: BIOL 229.

BIOL 231 DEVELOPMENTAL BIOLOGY 3.0: 3 cr. E

Description of the major events of the embryonic development in many organisms. Study of the molecular mechanisms that control this development.

Pre-requisite: BIOL 203.

BIOL 232 DEVELOPMENTAL BIOLOGY LABORATORY 0.3: 1 cr. E

Thorough practical investigation of the different developmental stages in a number of animals belonging to different classes.

Co-requisite: BIOL 231.

BIOL 233 ENDOCRINOLOGY **3.0: 3 cr. E**

This course deals with hormones, their structure, synthesis, secretion, role, and regulation. It deals also with related diseases and disorders.

Co-requisite: BIOL 213.

BIOL 235 REPRODUCTIVE BIOLOGY& *in vitro* FERTILIZATION **3.0: 3 cr. E**

This course discusses subject matters related to reproductive biology, embryology, and bioethics related to this topic.

Pre-requisite: BIOL 225.

BIOL 236 REPRODUCTIVE BIOLOGY& *in vitro* FERTILIZATION LAB **0.3: 1 cr. E**

Practical investigation of the reproductive system and embryonic development in animal systems

Co-requisites: BIOL 235.

BIOL 241 BOTANY **3.0: 3 cr. E**

An evolutionary survey of the plant kingdom: Classification, morphology and anatomy, adaptations for survival, and representative types and life cycles from the simplest to the most advanced groups.

Pre-requisite: BIOL 201.

BIOL 242 BOTANY LABORATORY **0.3: 1 cr. E**

Field and laboratory exercises to study plants ranging from the simplest to the most advanced groups. Identification of structural features of lower and higher plants.

Co-requisite: BIOL 241.

BIOL 243 PLANT ANATOMY **3.0: 3 cr. E**

Origins, evolution and differentiation of plant tissues and organs with emphasis on the anatomy of vascular plants.

Pre-requisite: BIOL 201.

BIOL 244 PLANT ANATOMY LABORATORY **0.3: 1 cr. E**

Preparation and examination of different fixed plant tissues using light microscopy. Practical study of structure-function relationships.

Co-requisite: BIOL 243.

BIOL 245 PLANT PHYSIOLOGY **3.0: 3 cr. E**

Selected aspects of the chemical and physical processes occurring in plants, including water relations and transpiration, photosynthesis, respiration, translocation of sugars, the assimilation of nitrogen and sulfur, mineral nutrition, growth and development, phytohormones and the metabolism of lipids and natural products.

Pre-requisite: BIOL 201.

BIOL 246 PLANT PHYSIOLOGY LABORATORY **0.3: 1 cr. E**

Introduction to experimental techniques used to study the biochemistry and physiology of plant growth.

Co-requisite: BIOL 245.

BIOL 247 ECONOMIC PLANT BIOLOGY **3.0: 3 cr. E**

The importance of plants and their products in human life. Evolution and use of plant products in food and

medicine with an overview of their potential use in biotechnology.

Pre-requisite: BIOL 201.

BIOL 249 PLANT SECONDARY METABOLISM **3.0: 3 cr. E**

In depth description of plant natural products, their nature, metabolism and role in plant interactions with other living organisms.

Pre-requisite: BIOL 245.

BIOL 251 PRINCIPLES OF BIOCHEMISTRY **3.0: 3 cr. E**

The course is designed to introduce the basic concepts of biochemistry. Coverage includes a thorough description of the biochemical framework: amino acids, proteins, enzymes, lipids, carbohydrates & nucleic acids. In addition, the course provides an overview of bioenergetics and metabolism of carbohydrates, lipids and amino acids.

Pre-requisite: BIOL 203; Co-requisite CHEM 244 or CHEM 240.

BIOL 261 MICROBIOLOGY **3.0: 3 cr. E**

Explores the biology of microorganisms. Study of the microbial cell structure and function, physiology, metabolism, genetics, diversity, and ecology. Applied aspects of microbiology will also be covered, such as biotechnology, the role of microorganisms in environmental processes, and medical microbiology. Pre-requisite: BIOL 203.

BIOL 262 MICROBIOLOGY LABORATORY **0.3: 1 cr. E**

Basic laboratory techniques for isolating, examining, and identifying bacteria, fungi, and viruses; elementary immunological techniques.

Co-requisite: BIOL 261.

BIOL 263 NUTRITION **3.0: 3 cr. E**

Integrated overview of the physiological requirements of energy, and functions of the major nutrients that are determinants of health and disease. The topics include also dietary soursces, intake levels, assessment of nutrient status in individuals and populations; the development of dietary guidelines and of nutrition policies in different countries; and the role of diet on the development of chronic diseases, such as cardiovascular disease, cancer, diabetes, ect.

Pre-requisite: BIOL 251.

BIOL 264 NUTRITION LABORATORY **0.3: 1 cr. E**

An investigation into the constituents of the major nutrients in the human diet. The laboratory includes testing of foods for composition and contamination.

Co-requisite: BIOL 263.

BIOL 265 PARASITOLOGY & VIROLOGY **3.0: 3 cr. E**

General description of animal parasites: classification, morphology, life cycles and physiology.

Pre-requisite: BIOL 261.

BIOL 266 PARASITOLOGY & VIROLOGY LABORATORY **0.3: 1 cr. E**

Practical application to the course material including diagnosis, identification of the most widespread types of parasites.

Co-requisite: BIOL 265.

BIOL 271 PRINCIPLES OF SOIL SCIENCE **3.0: 3 cr. E**

Introduction to soil science with an emphasis on soil genesis and development. Overview of the physical and mechanical characteristics. Plant, soil, water relations, microbial activities, and organic matter will be discussed.

Pre-requisites: BIOL 201, CHEM 202.

BIOL 272 PRINCIPLES OF SOIL SCIENCE LABORATORY **0.3: 1 cr. E**

Examination of structure and texture of soils, determination of biological, physical and chemical characteristics of various soil samples.

Co-requisite: BIOL 271.

BIOL 283 GENETICS **3.0: 3 cr. E**

Organization, expression and evolution of hereditary elements in Prokaryotes and Eukaryotes; principles of the classical Mendelian Genetics and extension to population analysis; principles of molecular genetics: DNA structure and organization in chromosomes and genes, mutations and gene expression.

Pre-requisite: BIOL 203.

BIOL 284 GENETICS LABORATORY **0.3: 1 cr. E**

Applications of genetic principles are reviewed through demonstrations, problem solving, and research. Experimental techniques employed in the study of genetics utilizing plants, animals, and microorganisms. Co-requisite: BIOL 283.

BIOL 285 MOLECULAR BIOLOGY **3.0: 3 cr. E**

Molecular mechanisms involved in the expression of genetic information, the control of macromolecular synthesis, the aggregation of macromolecules into DNA-protein complexes, membranes, chromosomes and cell organelles, and an introduction to recombinant DNA technology.

Pre-requisite: BIOL 283.

BIOL 286 MOLECULAR BIOLOGY LABORATORY **0.3: 1 cr. E**

Required laboratory includes an introduction to protein purification techniques, gene cloning, and recombinant DNA technology.

Co-requisite: BIOL 285.

BIOL 287 BIOTECHNOLOGY & RECOMBINANT DNA **3.0: 3 cr. E**

A course which deals with recombinant DNA technology and its uses in the various fields of Biology such as plant and animal amelioration, and bioremediation.

Pre-requisite: BIOL 283.

BIOL 291 SPECIAL TOPICS IN BIOLOGY **3.0: 3 cr. E**

Course discussing various topics of Biology with special contemporary importance. Subjects may include advances in technical and theoretical knowledge as well as discussions of specific topics like cancer, cloning, theoretical biology, etc.

Pre-requisite: BIOL 203.

BIOL 292 SEMINARS IN BIOLOGY **1.0: 1 cr. E**

Special course discussing topics of high interest presented by invited faculty or by students.

BIOL 293 BIOETHICS **1.0: 1 cr. E**

A course discussing various bioethical and moral issues related to artificial reproductive technologies, stem cell controversy or other medical related issues.

Pre-requisite: BIOL 203.

BIOL 294 TRAINING IN FERTILITY UNIT **0.4: 2 cr. E**

Training in the hospital or lab on the various stages of preperation of gametes and the procedure of in vitro fertilization.

Pre-requisite: BIOL 236.

CSPR 201, 202, 203, 204, 205, 206

Refer to the Civilization Sequence Program.

CHEM 202, 203, 222, 240, 242, 244, 245

Refer to the Department of Chemistry.

CSIS 273

Refer to the Department of Computer Science.

ENGL 203, 204

Refer to the Division of English Language & Literature.

MATH 242

Refer to the Department of Mathematics.

PHYS 211, 212, 213, 214

Refer to the Department of Physics.

DEPARTMENT OF CHEMISTRY

BACHELOR'S DEGREE

Mission Statement

The Department of Chemistry aims to provide its students, within the BS program, with the opportunity to learn about the traditional four main fields of chemistry and the corresponding emerging fields. This will be done through classroom courses, laboratory courses and research. Students are anticipated to acquire the basic concepts of chemistry, develop communication skills, as well as critical and analytical thinking. This will qualify them for opportunities in fields of education, industry, research (science, environment, health) and present them as scientifically literate citizens.

Program Learning Objectives

The BS program in Chemistry aims at providing students with the following knowledge and skills:
1- Understand the fundamentals in the various fields in chemistry
2- Acquire skills in problem solving and critical thinking
3- Acquire safety, operational and analysis skills required in chemistry laboratories
4- Communicate effectively in the chemistry field and develop interpersonal skills
5- Be able to join a graduate program in a field of study related to chemistry
6- Be able to fit in any related employment opportunity: such as research, industry, teaching and even administration

Program Learning Outcomes

Upon the successful completion of the BS curriculum in Chemistry, graduates are anticipated to:
1- Explain the atomic theory, periodic table, molecular geometry and bonding.
2- Solve problems related to stoichiometry and chemical equilibrium.
3- Classify acids and bases, write their reactions and draw their titration curves.
4- Deal with the different states of matter: liquids, gas and solids.
5- Solve problems related to electrochemistry and thermochemistry.
6- Explain the stereochemistry of different organic compounds.
7- Write mechanisms of the major classes of organic reactions
8- Name, prepare and synthesize the different organic functions.
9- Identify structure of compounds based on spectroscopic techniques.
10- Explain coordination chemistry.
11- Operate basic equipment and run an experiment in a Chemistry lab.
12- Deal with the rate of different chemical reactions.
13- Solve problems to physical and chemical kinetics.

PRE-MED TRACK

The Bachelor's Degree Curriculum in Chemistry includes all courses recommended to prepare students for the MCAT. These courses are:

Biology*	***A minimum of 8 credits***
Chemistry	***A minimum of 12 credits including 3 credits of organic chemistry***
Humanities and Social Sciences	***A minimum of 6 credits***
Physics	***A minimum of 8 credits***

* The Bachelor's Degree Curriculum in Chemistry includes 18 credits of free electives which allow students to ***meet the Biology course requirement for the MCAT examination without the need for extra credits***.

MINOR IN CHEMISTRY

The Faculty of Sciences offers a Minor in Chemistry for students who have successfully completed a minimum of 18 credits of chemistry courses as follows:

Code	Course Title	Credit
CHEM 202	Basic Chemistry	3
CHEM 222	Analytical Chemistry I	3
CHEM 240 *	Basic Organic Chemistry	3
CHEM 246	Applied Molecular Spectroscopy	3
CHEM 260	Statistical Mechanics & Thermodynamics	3
CHEM 262	Physical and Chemical Kinetics	3

* A student who is already registered for CHEM 242 and CHEM 244 to meet "pre-medical" requirements need not register for CHEM 240 to meet " Minor in Chemistry " requirements.

BACHELOR'S DEGREE

SEMESTER 1

Course Code	Course Title	Credit
CHEM 202	Basic Chemistry	3
CHEM 203	Basic Chemistry Lab	1
CSIS 273	Personal Computing for Applied Sciences	3
ENGL 203	English Communication Skills III	3
LISP 200	Library Use ana Research Methods	1
MATH 200	Calculus I	3
	Elective	3
Total		**17**

SEMESTER 2

Course Code	Course Title	Credit
CHEM 222	Analytical Chemistry I	3
CHEM 242	Organic Chemistry I	3
ENGL 204	English Communication Skills IV (or Equivalent)	3
MATH 270	Differential Equations	3
PHYS 211	Fundamentals of Physics I	3
PHYS 212	Fundamentals of Physics I Lab	1
Total		**16**

SEMESTER 3

Course Code	Course Title	Credit
CHEM 244	Organic Chemistry II	3
CHEM 245	Organic Chemistry Lab I	1
CHEM 260	Statistical Mechanics and Thermodynamics	3
CSPR 201	Civilization and Relegion	3
PHYS 213	Fundamentals of Physics II	3
PHYS 214	Fundamentals of Physics II Lab	1
	Elective	3
Total		**17**

SEMESTER 4

Course Code	Course Title	Credit
CHEM 224	Analytical Chemistry II	3
CHEM 246	Applied Molecular Spectroscopy	3
CHEM 247	Organic Chemistry Lab II	1
CHEM 262	Physical and Chemical Kinetics	3
CHEM 270	Inorganic Chemistry I	3
CSPR 202	Philosophy and Culture	3
Total		**16**

SEMESTER 5

Course Code	Course Title	Credit
CHEM 223	Analytical Chemistry Lab	1
CHEM 272	Inorganic Chemistry II	3
CSPR 203	Cultures and Society	3
	Electives	6
Total		**13**

SEMESTER 6

Course Code	Course Title	Credit
CHEM 263	Physical Chemistry Lab	1

CHEM 264	Quantum Theory and Structure of Matter	3
CSPR 204	Arabic Thought and Culture	3
	Electives	6
Total		**13**
Total credits		**92**

CHEMISTRY ELECTIVE COURSES

I- Within the Department

Course Code	Course Title	Credit
CHEM 280	Chemical Safety and Toxicology	3
CHEM 282	Food Chemistry	3
CHEM 284	Biogeochemistry	3
CHEM 286	Polymer Chemistry	3
CHEM 288	Methods of Analysis	3
CHEM 290	Industrial Chemistry	3
CHEM 292	Environmental Chemistry	3
CHEM 294	Green Chemistry	3
CHEM 296	Water and Soil Chemistry	3
CHEM 298	Special Topics in Chemistry	3

COURSE DESCRIPTIONS

CHEM 001 SOP CHEMISTRY **3.0: 3 cr. E**

This is a basic chemistry course for students in the Special Orientation Program (SOP). SOP students normally study Chemistry in Arabic. It is the aim of this course to make the students familiar with the English terminology. Accordingly, the course reviews the topics usually taken at the Third Secondary Level such as: Atomic theory, stoichiometry, oxidation & reduction, ideal gas laws, quantum chemistry, chemical equilibrium and an introduction to organic chemistry.

CHEM 100 INTRODUCTION TO CHEMISTRY I **3.0: 3 cr. E**

Basic Chemistry Level I for Freshman students in the Scientific section. An elective for Freshman students in the Literary section. Accordingly, the course covers the following topics: Atomic theory of matter, types of reactions, concepts of acids and bases, molecular and ionic equations, oxidation-reduction reactions, calculations with chemical formulas and equations, stoichiometry, empirical gas laws, the ideal gas law, introduction to quantum chemistry.

CHEM 101 INTRODUCTION TO CHEMISTRY I LABORATORY **0.3: 1 cr. E**

The aim of this course is to introduce and familiarize Freshman students with the laboratory environment. Students will learn how to safely handle chemical reagents, glassware and basic apparatus by carrying out experiments such as precipitation, electrical conductivity of solutions, acid-base titration, melting point determination, distillation, etc.

Co-requisite: CHEM 100.

CHEM 102 INTRODUCTION TO CHEMISTRY II **3.0: 3 cr. E**

Basic Chemistry Level II for Freshman students in the Scientific section. Accordingly, the course covers the following topics: types of chemical bonds, electronegativity and polarity, rate of a chemical reaction, half

life, chemical equilibrium, Le-Chaterlier's principle, Equilibrium in aqueous solutions (acids, bases, buffer), solubility, introduction to organic chemistry: hydrocarbons, hybridization, alkanes and cycloalkanes, alkenes, alkynes, aromatic hydrocarbons, reactions of hydrocarbons, organic compounds containing oxygen. Reaction of oxygen containing organic compounds, organic compounds containing nitrogen, and organic polymers.

Pre-requisite: CHEM 100.

CHEM 103 INTRODUCTION TO CHEMISTRY II LABORATORY 0.3: 1 cr. E

In this laboratory course, Freshman students will carry out experiments such as precipitation, electrical conductivity of solutions, acid-base titration, melting point determination, distillation, etc.

Co-requisite: CHEM 102.

CHEM 110 INTRODUCTION TO FOOD CHEMISTRY AND NUTRITION 3.0: 3 cr. E

An introductory course for the exploration of the structure, properties, and chemical composition of food systems and the changes they undergo during processing and under storage. Basic food chemistry provides the student with knowledge of the three primary food constituents: carbohydrates, lipids and proteins and some of the main reactions between them. The Caloric concept of different food components is also discussed.

CHEM 150 INTRODUCTION TO THE SCIENCE OF COSMETICS 3.0: 3 cr. E

This is an enjoyable course for all students regardless of their educational formation or background. Cosmetics and toiletries are products of our every day life, ranging from the use of toothpastes, hair gels, deodorants, facial soaps, shampoos, hair conditioners and many others. Understanding how these products are made and how they work will enable you to decide which product to buy and which serves simply as a commercial tool. The student will also become familiar with basic perfume manufacturing process.

At the end of the course, each pupil will "manufacture" his/her own product they chose. The list includes shampoos, shaving creams, toothpastes, hand creams etc.

CHEM 202 BASIC CHEMISTRY 3.0: 3 cr. E

This is a course in basic chemistry which introduces the students to various important topics such as the origin of the atomic theory, atomic weights and formulae, stoichiometry and the mole concept and their applications in various types of chemical reactions. The course will also discuss acids, bases and their applications, properties of gases and their laws. In addition, important topics such as liquids and solutions, chemical equilibrium, quantum theory and structure of atoms, as well as, molecular geometry and thermo-chemistry will be discussed.

Pre-requisite: CHEM 102.

CHEM 203 BASIC CHEMISTRY LABORATORY 0.3: 1 cr. E

This is a course in basic chemistry laboratory which introduces the students to the following topics: Precision of measurement, acid-base titration, oxidation-reduction titration, spectrophotometry, Group I cations, acid-base potentiometric titration, solubility of sodium bicarbonate, Ksp of calcium chloride, anions and total hardness of water. This course provides an opportunity for our students to be engaged in actual chemical procedures where practical experience will be gained as a result.

Co-requisite: CHEM 202.

CHEM 208 BASIC CHEMISTRY FOR PUBLIC HEALTH (PDHP 202) 3.0:3 cr. E

This course introduces Public Health students to the basic principles of chemistry. The course discusses basic general and organic chemistry, water chemistry, atmospheric chemistry, Inorganic and Organic pollutants as well as hazardous waste.

(Students who have already completed CHEM 202 may be granted equivalence)

CHEM 209 BASIC CHEMISTRY LABORATORY FOR PUBLIC HEALTH (PDHP 203) 0.3:1 cr. E

This is a laboratory course which introduces public health students to experiments in basic and applied chemistry.

(Students who have already completed CHEM 203 may be granted equivalence)

CHEM 222 ANALYTICAL CHEMISTRY I 3.0: 3 cr. E

This is a fundamental course in Analytical chemistry that covers the following topics: Errors in chemical analysis, Statistical evaluation of analytical data, Gravimetric methods of analysis, Titrimetric methods of analysis, Aqueous solution chemistry, Activities and activity coefficients, Equilibrium calculations, Precipitation titration, Neutralization titration, Complex acid-base systems, Complex-formation titration, Electrochemistry, Applications of oxidation-reduction Titrations, and Chemical Kinetics.

Pre-requisite: CHEM 202.

CHEM 223 ANALYTICAL CHEMISTRY LAB 0.3: 1 cr. E

This course aims, to familiarize students with the laboratory environment and to introduce them to the proper and safe way of running an experiment in analytical chemistry. The experiments are designed to adapt the students with the manipulation of modern analytical instruments such as Potentiometer, pH-meter, Conductometer, Voltmeter, Amperometer, etc.

Pre-requisite: CHEM 203 & 222

CHEM 224 ANALYTICAL CHEMISTRY II 3.0: 3 cr. E

This is an advanced course in Analytical Chemistry that aims to prepare students for graduate studies and research. In this course students will learn about the principles, instrumentations and applications of various research techniques, will attend seminars, and carry out a short research project that they have to present towards the end of the semester in front of a jury. The research techniques covered are a selection from: Potentiometry, Electrogravimetry, colorimetry, Voltametry, Spectroscopy, Chromatography, NMR and Mass Spectrometry.

Pre-requisite: CHEM 222.

CHEM 240 BASIC ORGANIC CHEMISTRY 3.0: 3 cr. E

This course outlines the combined theories and fundamental concepts of organic chemistry, including structure, shape, IUPAC nomenclature, stereoisomerism, optical activity, absolute configuration and properties of the following groups: alkanes, alkenes, alkynes and aromatic hydrocarbons; compounds containing functional groups such as halogen, hydroxyl, carbonyl, carboxylic acids and amines. Emphasis is put on important synthesis methods and reagents, basic reaction mechanisms, important naturally-occurring and synthetic organic compounds.

Pre-requisite: CHEM 202.

Students cannot receive credit for both CHEM 240 and CHEM 242. Students cannot receive credit for both CHEM 240 and CHEM 244. Chemistry major students will not receive credits for CHEM 240.

CHEM 242 ORGANIC CHEMISTRY I 3.0: 3 cr. E

This Chemistry course introduces the students to the following topics : Methane and Alkanes, Stereochemistry, Substitution and Elimination reactions involving mechanism, Alkenes, Alkynes, Dienes, Alcohols, Ethers and cyclic aliphatic compounds.

Pre-requisite: CHEM 202

Students cannot receive credits for both CHEM 240 and CHEM 242.

CHEM 244 ORGANIC CHEMISTRY II **3.0: 3 cr. E**

This course aims to furnish students with the theoretical skills in organic chemistry. In the first part of the course, students will deal with aromatic-aliphatic compounds (essentially benzene and arenes). In the second part, the course will discuss the main functional groups: alcohols, phenols, ethers and epoxides, aldehydes and ketones, carboxylic acids and derivates, amine and amides. The third part will briefly cover spectroscopic techniques (H-NMR and IR) and explain the structure determination of organic molecules.
Students cannot receive credit for both CHEM 240 and CHEM 244.
Pre-requisite: CHEM 242

CHEM 245 ORGANIC CHEMISTRY LAB I **0.3: 1 cr. E**

This is a course in organic chemistry laboratory 1 which introduces the students to the following topics: melting point, boiling point, distillation, crystallization, liquid-liquid extraction, drying agents, isolation of caffeine from natural sources, synthesis of acetyl salicylic acid, chemistry of alcohols, the amylenes: 2-methyl-2-butene, preparation of alkyl halides, adsorption chromatography and reactions of aldehydes and ketones. This course provides an opportunity for our students to be engaged in actual chemical procedures where practical experience will be gained as a result.

Pre-requisite: CHEM 202, 203 & 242.
Co-requisite: CHEM 244. or
Pre-requisite: CHEM 202, 203 & 240.

CHEM 246 APPLIED MOLECULAR SPECTROSCOPY **3.0: 3 cr. E**

This course outlines principles and instrumentation of a number of spectroscopic techniques such as: Nuclear Magnetic Resonance, Infrared, Ultraviolet, and Visible spectroscopy, in addition to Mass Spectrometry. Students will analyze IR, UV, NMR and mass spectra to identify and determine the structure of an organic compound.

Pre-requisite: CHEM 244 or 240.
Co-requisite: CHEM 224.

CHEM 247 ORGANIC CHEMISTRY LAB II **0.3: 1 cr. E**

This is a course in organic chemistry laboratory II which introduces and familiarizes the students with advanced techniques used in organic chemistry laboratories. Various topics such as preparation of an aldehyde and propionaldehyde, tests of characterization (Tollens', Fehling), preparation, separation, and characterization of phenolic compounds, esters, quinones, monophenylurea, benzoin, benzyl and benzilic acid. The course also discusses and entails the properties of benzaldehyde (Cannizaro reaction), Storage and Release of Light Energy: benzopinacol and Luminol, Reactions of Carbohydrates, as well as Amino Acids and Proteins. This course provides an opportunity for our students to be engaged in actual chemical procedures where practical experience will be gained as a result.

Pre-requisite: CHEM 244, 245, 262.

CHEM 260 STATISTICAL MECHANICS AND THERMODYNAMICS **3.0: 3 cr. E**

The course covers properties of gases, The First Law of thermodynamics: concepts and machinery, The Second Law of thermodynamics: concepts and machinery, Change of state and Equilibrium electrochemistry.

Pre-requisite: CHEM 202 and MATH 270.

CHEM 262 PHYSICAL AND CHEMICAL KINETICS **3.0: 3 cr. E**

This course deals with the theoretical aspects of chemical reaction kinetics, including rate laws, rate constants, classification of kinetic processes: order of reaction, quasistationarity principle, analysis of kinetic data (integration, differential, isolation, and relaxation methods), formal description of complex reactions: sequential reactions, parallel reactions, reversible reaction, enzyme kinetics, simplification of the description of complex reactions: chemical and mathematical methods, temperature and pressure dependence of the reaction

rate. In addition, migration properties of gases (diffusion, heat transfer, viscosity,…) are considered with an eye on the relation to collision theory and its implication in theoretical chemical kinetics. Moreover, the course deals with the experimental aspects of chemical reaction kinetics including stopped flow, fast and ultra-fast processes, temperature-jump relaxation methods, molecular beam, shock tube and flash photolysis techniques. Reactions in the gas phase, liquid phase, and on surfaces are discussed with examples drawn from atmospheric, combustion, industrial, catalytic, and biological chemistry.
Pre-requisite: CHEM 202 and MATH 270.

CHEM 263 PHYSICAL CHEMISTRY LAB **0.3: 1 cr. E**

This laboratory course includes experiments that study the following topics: 1st law of thermodynamics, Universal gas constant: Isobar and Isochor; Enthalpy of vaporization, Enthalpy of combustion, Enthalpy of formation, Enthalpy of reaction; Entropy; Trouton's rule, Raoult's law, Henry's law; Hess' law; Calorimetry; Reaction rate: concentration and temperature dependence.
Pre-requisite: CHEM 203, 260.
Co-requisite: CHEM 262 or 264.

CHEM 264 QUANTUM THEORY AND STRUCTURE OF MATTER **3.0: 3 cr. E**

This course deals with the theoretical aspects of quantum chemistry, including black body radiation, the photoelectric effect, Compton's effect, and other phenomena that show how classical mechanics fail to explain experimental observations. The spectrum of the hydrogen atom is explained using Bohr Theory before the consideration of hydrogenic atoms and electronic orbitals. A particle in different spaces is then considered and probability equations are developed to describe the behavior of the particle in a one, two and three dimensional potential wells. The tunneling effect is also considered followed by the introduction of the Schrödinger equation that is then applied to hydrogen, hydrogenic atoms and finally polyelectronic atoms. Spectral terms are then introduced and the effect of a magnetic field on the spectra of different atoms is detailed (Zeeman effect). Finally, the valence bond theory and molecular orbital theory are presented and insights in the orbitals present in polyatomic systems are investigated.
Pre-requisite: CHEM 202 and MATH 270.

CHEM 270 INORGANIC CHEMISTRY I **3.0: 3 cr. E**

This course presents the first concepts in Inorganic Chemistry. It starts from the atomic structure of elements and elaborates towards bonding and structures within inorganic molecules. The structure aspect is then discussed for simple ionic solids, with an introduction to solid-state phases. This is followed by the study of acids and bases as well as redox reactions from an inorganic perspective, and the discussion of molecular symmetry of different inorganic molecules.
Pre-requisite: CHEM 202.

CHEM 272 INORGANIC CHEMISTRY II **3.0: 3 cr. E**

This course builds up on the concepts discussed in CHEM 270 to focus on the study of coordination chemistry, a central part of Inorganic Chemistry. It introduces coordination compounds, their naming and structural features. It then elaborates towards d-metal complexes and their electronic structures and reactivity in particular, and finishes with an overview about organometallic chemistry. The physical techniques in studying and characterizing inorganic compounds are also discussed within the course.
Pre-requisite: CHEM 270.

CHEM 273 INORGANIC CHEMISTRY LAB **0.3: 1 cr. E**

Preparation of some inorganic compounds and study of their properties.
Pre-requisite: CHEM 270.
Co-requisite: CHEM 272.

CHEM 280 CHEMICAL SAFETY AND TOXICOLOGY **3.0: 3 cr. E**

This course provides an outline of the toxicological, occupational hygiene and environmental aspects of chemical hazards and exposures. Metals, solvents, toxic and irritant gases, pesticides, carcinogens, hazardous wastes and dioxins will also be discussed.

CHEM 282 FOOD CHEMISTRY **3.0: 3 cr. E**

This course outlines composition of food, their physical and sensory properties. The first part introduces the science of food chemistry with different definitions, abbreviations and tables. In the second part, water, mineral elements and vitamins are studied in details. In the third part carbohydrates, lipids and proteins in food are discussed.

Pre-requisite: CHEM 202.

CHEM 284 BIOGEOCHEMISTRY **3.0: 3 cr. E**

An interdisciplinary science course encompassing chemical reactions in the atmosphere, oceans, soil and sediment, and living organisms. It is a study about effects exerted by living systems on quality of the environment, impact on the global system, and the link existing between the atmosphere, the ocean and land.

Pre-requisite: CHEM 260 and 262.

CHEM 286 POLYMER CHEMISTRY **3.0: 3 cr. E**

Basics of polymer chemistry. Importance of polymers to our life. Stoichiometry of flexible chain molecules. Some microscopic features of bulk polymers. Methods for molecular characterization of polymers. Step and chain polymerization reactions-mechanisms and kinetics. Investigation onto co-polymerization strategy. Different polymerization methods.

Co-requisite: CHEM 270 & 272.

CHEM 288 SAMPLING & METHODS OF ANALYSIS **3.0: 3 cr. E**

This course is a combination of class and laboratory work; theory and application. It dwells on the principles of chemistry underlying the various methods and procedures. It prepares students for professional career in human and animal nutrition, industry and environmental sciences, as they learn how to collect, treat, store and digest samples, and how to run elemental analysis on the digest. It is designed to allow each student to obtain "hands-on" experience with the primary instrumentation available to chemists working in academia, industry, and government research.

Co-requisite: CHEM 222.

CHEM 290 INDUSTRIAL CHEMISTRY **3.0: 3 cr. E**

This Chemistry course introduces the students to the following topics: Nitrogen industries, Ceramic industries, Water purification and recycling, Soap and detergents, Portland Cement (Calcium and magnesium compounds), Glass industries, Phosphorous industries, Pollution, Sulfur and sulfuric acids.
Pre-requisite: CHEM 260 and 270.

CHEM 292 ENVIRONMENTAL CHEMISTRY **3.0: 3 cr. E**

Physics and chemistry of the ozone layer, catalytic processes; the ozone hole; urban ozone; acid rain, indoor and outdoor air pollution; mechanism of the greenhouse effect; climate-modifying effects of aerosols; toxic organic chemicals; pollution and purification of water; modern waste water and air purification techniques; toxic heavy metals; municipal wastes; soils and sediments; hazardous wastes; renewable energy.
Pre-requisite: CHEM 202.

CHEM 293 ENVIRONMENTAL CHEMISTRY LAB **0.3: 1 cr. E**

This lab would provide students with basic skills needed for environmental chemistry, with a focus on the extraction and analytical method development to study the mechanisms of environmental fate, transport, and removal of pollutants.
Pre-requisites: CHEM 202, 203.
Co-requisite: CHEM 292.

CHEM 294 GREEN CHEMISTRY **3.0: 3 cr. E**

Principles and concepts of green chemistry; sustainable development, atom economy, reducing toxicity; waste production and problems; costs and waste minimization techniques; measuring environmental performance; environmental management, eco-labels and legislation; catalysis and green chemistry; organic solvents and volatile organic compounds; solvent-free systems; alternative solvents; emerging greener technologies; industrial case studies; society and sustainability.
Pre-requisite: CHEM 292.

CHEM 296 WATER AND SOIL CHEMISTRY **3.0: 3 cr. E**

Concepts in aquatic chemistry; chemical reactions and chemical equilibrium; combining chemical reactions; chemical potentials; adsorptions reactions; soil composition; ion exchange; soil acidity and buffering; mineral weathering and formation; oxidation-reduction reactions in soils; salt-affected and swelling soils; effects of salt-degraded soils on plants; availability and mobility of toxic elements in soils; organic pollutants in soils.
Pre-requisite: CHEM 292.

CHEM 298 SPECIAL TOPICS IN CHEMISTRY **3.0: 3 cr. E**

CSPR 201, 202, 203, 204

Refer to the Civilization Sequence Program.

CSIS 273

Refer to the Department of Computer Science.

ENGL 203, 204

Refer to the Division of English Language & Literature.

MATH 200, 270

Refer to the Department of Mathematics.

PHYS 211, 212, 213, 214

Refer to the Department of Physics.

DEPARTMENT OF COMPUTER SCIENCE

The Department of Computer Science provides a fundamental education to prepare students for positions in industry, government, education, or commerce, or to pursue graduate study. It offers the following degrees:

- BS in Computer Science with 2 options:
  - Software Engineering
  - Information Systems
- BS in Computer Science with Teaching Diploma
- MS in Computer Science, with 3 options:
  - Software Engineering
  - Information Systems
  - Health Information Systems

BACHELOR'S DEGREE IN COMPUTER SCIENCE

OPTION SOFTWARE ENGINEERING

Program Features

Software Engineering is the discipline of developing and maintaining software systems that behave reliably and efficiently, are affordable to develop and maintain, and satisfy all the requirements that customers have defined for them. This is achieved with an integration of the Mathematics principles and Computer Science with the Engineering practices.

Learning outcomes

Graduates are expected to:

- Effectively apply knowledge of programming, algorithms, data structures, and software engineering to the development of software systems
- Communicate technical concepts effectively in both written documents and oral presentations
- Design and analyze software at all levels and make informed, sound, software design decisions
- Understand the social and ethical issues that arise in their work and deal with them professionally
- Understand the importance of all phases of the software lifecycle, with emphasis on the need to plan for change and continuously vie to improve the software process
- Work effectively in a software development team and with other professionals
- Appreciate the need for lifelong learning and adapt to rapid technological changes
- Be able to analyze, design, verify, validate, implement, apply and maintain software systems.

Career Opportunities

Software Engineering graduates excel as software developers and can quickly become experts at developing large scale software, working in teams and producing robust products that meet customer needs. They are prepared to work in a diverse marketplace and find opportunities in a wide variety of careers in IT, business, education, government and the non-profit sectors.

BACHELOR'S DEGREE IN COMPUTER SCIENCE
OPTION INFORMATION SYSTEMS

Program Features

The Information Systems option combines mastery of management processes and a thorough knowledge of Information Technology, offered in a dynamic framework, a multidisciplinary approach and state-of-the-art laboratories.

Learning Outcomes

Specific objectives of the Information Systems option are to produce graduates who can:

- Analyze, design, implement, and test a solution to real world problems, including appreciating the value of efficient design created to meet clearly developed requirements
- Write technical documents such as specifications, design and use manuals in appropriate formats
- Orally present deliverables related to their specialization
- Blend their Software Engineering abilities with skills specific to Management to solve problems in Business
- Have a basic understanding of information science and business and their linkages to key technologies
- Have an enthusiasm for the educational process and for professional practices
- Work in interdisciplinary groups consisting of non-technical and technical members.

Career Opportunities

Information Technology is used practically in all fields of administration, from small businesses to large corporations and from governmental and non-governmental organizations to private institutions, such as hospitals, schools, universities, etc.

MINOR IN COMPUTER SCIENCE

A non Computer Science student wishing to minor in Computer Science must successfully complete 18 credits constituted of the following courses: CSIS 200 (3cr.), 215 (3cr.), 216 (3cr.), 222 (3cr.), 270 (3cr.), 285 (1cr.), 286 (1cr.), and 287 (1cr.)

BACHELOR'S DEGREE IN COMPUTER SCIENCE
OPTION SOFTWARE ENGINEERING

FIRST YEAR

SEMESTER 1

Course Code	Course Title	Credit
ACCT 202	Survey of Accounting & Finance	3
CSIS 200	Introduction to Computers & Programming	3
CSIS 285	Basic Programming Lab	1
ENGL 203	English Communication Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra I	3
Total		**16**

SEMESTER 2

Course Code	Course Title	Credit
CSIS 215	Object Oriented Programming	3
CSIS 222	Networking Principles and Design	3
CSIS 270	Databases	3
CSIS 286	Object Oriented Programming Lab	1
ENGL 204	English Communication Skills IV	3
MATH 246	Probability	3
LISP 200	Library Use and Research Methods	1
Total		**17**

SECOND YEAR

SEMESTER 3

Course Code	Course Title	Credit
CSPR 201	Civilization and Relegion	3
CSIS 210	Computer Organization & Assembly Language	3
CSIS 216	Data Structures	3
CSIS 271	Database Technologies	3
CSIS 276	Systems Analysis and Design	3
CSIS 287	Data Structures Lab	1
Total		**16**

SEMESTER 4

Course Code	Course Title	Credit
CSPR 202	Philosophy and Culture	3
CSIS 217	Advanced Data Structures	3
CSIS 231	Java Technologies	3
CSIS 235	Mobile Computing	3
CSIS 288	Mobile Programming Lab	1
MATH 230	Numerical Analysis	3
Total		**16**

{Four-Week Training followed by a report submitted to the Department}

THIRD YEAR

SEMESTER 5

Course Code	Course Title	Credit
CSPR 203	Cultures and Society	3
CSIS 221	Operating Systems	3
CSIS 223	Network Configuration and Programming	3
CSIS 278	Software Engineering and Quality Assurance	3
CSIS 279	Advances in Computer Science	3
	Elective	2
Total		**17**

SEMESTER 6

Course Code	Course Title	Credit
CSPR 204	Arabic Thought and Culture	3
CSIS 250	Computer Graphics	3
CSIS 260	Introduction to Artificial Intelligence	3
CSIS 290	Senior Project	3
	Elective	3
Total		**15**

Total credits **97**
(LISP 200 is free of charge)

BACHELOR'S DEGREE IN COMPUTER SCIENCE OPTION INFORMATION SYSTEMS

FIRST YEAR
SEMESTER 1

Course Code	Course Title	Credit
CSIS 200	Introduction to Computers & Programming	3
CSIS 274	End User Computing	3
CSIS 285	Basic Programming Lab	1
ENGL 203	English Communication Skills III	3
MATH 201	Mathematics for Computation	4
ACCT 202	Survey of Accounting and Finance	3
Total		**17**

SEMESTER 2

Course Code	Course Title	Credit
CSIS 215	Object Oriented Programming	3
CSIS 222	Networking Principles and Design	3
CSIS 270	Databases	3
CSIS 286	Object Oriented Programming Lab	1
ENGL 204	English Communication Skills IV	3
MATH 240	Probability and Statistics	4
LISP 200	Library Use and Research Methods	1
Total		**18**

SECOND YEAR
SEMESTER 3

Course Code	Course Title	Credit
CSPR 201	Civilization and Relegion	3
CSIS 216	Data Structures	3
CSIS 271	Database Technologies	3
CSIS 276	Systems Analysis and Design	3

CSIS 287	Data Structures Lab	1
ECON 201	Survey of Economics	3
Total		**16**

SEMESTER 4

Course Code	Course Title	Credit
CSPR 202	Philosophy and Culture	3
CSIS 231	Java Technologies	3
CSIS 232	Electronic Commerce	3
CSIS 235	Mobile Computing	3
CSIS 288	Mobile Programming Lab	1
MATH 261	Operations Research	3
Total		**16**

{Four-Week Training followed by a report submitted to the Department}

THIRD YEAR

SEMESTER 5

Course Code	Course Title	Credit
CSPR 203	Cultures and Society	3
CSIS 221	Operating Systems	3
CSIS 278	Software Engineering and Quality Assurance	3
CSIS 279	Advances in Computer Science	3
MGMT 220	Principles of Management	3
Total		**15**

SEMESTER 6

Course Code	Course Title	Credit
CSPR 204	Arabic Thought and Culture	3
CSIS 277	Information Systems Management	3
CSIS 290	Senior Project	3
MRKT 220	Principles of Marketing	3
	Elective	3
Total		**15**

Total credits **97**

(LISP 200 is free of charge)

COURSE DESCRIPTIONS

CSIS 200 INTRODUCTION TO COMPUTERS & PROGRAMMING 3.0: 3 cr. E

This course provides students with a foundation of computing and algorithmic principles. It is intended to establish concrete skills in the constructs and algorithmic methods as an essential part of the software development process. Teaching is carried out by way of a lecture-and-homework agenda that emphasizes the design, construction, and analysis of algorithms, coupled to a lab-and-project agenda focused on the application of those principles in the use of software packages. Lecture-and-homework topics include: pseudo-language, algorithms, programming life cycle, procedural programming versus object-oriented programming, abstraction, objects and classes, decision constructs and repetition structures.
Co-requisite: CSIS 285.

CSIS 203 FUNCTIONAL PROGRAMMING 3.0: 3 cr. E

Programming with functions, top-down decomposition and stepwise refinement, higher-order functions, referential transparency, Lazy evaluation. The application language is LISP.
Pre-requisite: CSIS 200.

CSIS 205 FORMAL SPECIFICATION & VERIFICATION OF PROGRAMS 3.0: 3 cr. E

Mathematical and logical backgrounds, program specifications, program derivation, theories and tools for program derivation, proofs of correctness.
Pre-requisite: CSIS 216.

CSIS 206 PRINCIPLES OF PROGRAMMING 3.0: 3 cr. E

This course is designed to introduce students to the concept of computing and programming principles. It is intended to establish concrete skills in the constructs and algorithmic methods as an essential part of the software development process. The topics include: algorithms, procedural programming, data representation, basic programming control structures (sequence, selection and repetition), functional decomposition, functions call and arrays.
Not offered only to computer science students.

CSIS 207 SENIOR TOPICS IN COMPUTER SCIENCE 3.0: 3 cr. E

The course covers topics of current interest in Computer Science that do not fall into a standard subarea of the curriculum. The course load involves lectures and a project. Through this project students will get hands-on experience, designing and implementing an interesting application. It is expected that the course will help students develop software design, analysis and implementation abilities through working with innovative tools and methodologies in some emerging area of high importance. Course content is revised and topics are selected on a yearly basis.
Pre-requisite: CSIS231.

CSIS 210 COMPUTER ORGANIZATION & ASSEMBLY LANGUAGE 3.0: 3 cr. E

An introduction to computer organization and assembly programming covering the general structure of a microprocessor-based computer with detailed description of the data, address, and control buses used on the 8086 microprocessor. It also covers the assembly process and the instruction set of the 8086. In addition, it discusses I/ O and memory management.
Pre-requisite: CSIS 200.

CSIS 213 COMPILER DESIGN & CONSTRUCTION 3.0: 3 cr. E

Overview of compilers including component functions and classification. Symbol table construction and operations; lexical analysis, parsers, code generation, and error handling. Intermediate code generation and compiler generators.

Pre-requisite: CSIS 216.

CSIS 214 COMPUTER ARCHITECTURE **3.0: 3 cr. E**

A quantitative approach to the study of computer architecture with emphasis on the basics of the RISC processors. Instructions set principles, pipelining, and principles of memory-hierarchy design, I/O, and storage systems.

Pre-requisite: CSIS 210.

CSIS 215 OBJECT ORIENTED PROGRAMMING (CSIS201 previously) **3.0: 3 cr. E**

This is an advanced programming course. It covers the programming paradigms with examples, and the transition between modular programming and object-oriented programming. The course also covers data categorization and subdivision into classes and discusses inheritance of operations from one class to another. Topics include: Advanced Arrays, Files, object-oriented analysis and design, class abstraction, encapsulation, inheritance, polymorphism, Composition, Exception Handling, and Binary I/O.

Pre-requisite: CSIS 200.

Co-requisite: CSIS 286.

CSIS 216 DATA STRUCTURE (CSIS202 previously) **3.0: 3 cr. E**

The aim of this course is to provide an introduction to computer algorithms and data structures, with an emphasis on foundational material. Students will learn how to model data in a computer, how to specify and use standard ADTs, and how to implement such ADTs with standard data structures. An object-oriented approach to data structures and algorithms. Topics include: Recursive thinking, Generics, different data structure such as array and dynamic arrays, sorting algorithms, Time/Complexity analysis techniques, pointer based structure, and linked list, stacks, queues and priority queues.

Pre-requisite: CSIS215.

Co-requisite: CSIS 287.

CSIS 217 ADVANCED DATA STRUCTURE (CSIS204 previously) **3.0: 3 cr. E**

The course is intended to deepen the clear understanding of both theory and implementation details underlying the advanced data structures and data abstractions such as: trees, binary search trees, graphs, weighted graph, Avl trees and search trees, hash tables, and GUI Basics. It is also to strengthen the students' ability to write correct programs using these and related data structures.

Pre-requisite: CSIS 216.

CSIS 220 SYSTEMS PROGRAMMING **3.0: 3 cr. E**

The UNIX operating system is introduced as a programming environment. Topics include: the C language and libraries, history and overview of the UNIX operating system, the file structure, the shell, graphical user interfaces, the vi editor, programming the Bourne, the C and the Korn shell, UNIX utility programs, and UNIX networking.

Pre-requisite: CSIS 210.

CSIS 221 OPERATING SYSTEMS **3.0: 3 cr. E**

This course is a comprehensive survey of operating systems principles. Topics covered include: process description and control, threads, process and disk scheduling, file and memory and I/O management, concurrency, networking and distributed processing, security.

CSIS 222 PRINCIPLES OF COMPUTER NETWORKING AND COMMUNICATION **3.0: 3 cr. E**

This course is an introduction to network principles and network design. Topics include: Basic concepts and terminology of computer networks, networking models and theory, networking protocols, LAN, WAN, MAN, wireless and mobile network technologies, network performance, network security, layers of the Internet Protocol Suite (the TCP/IP family of protocols), Internet addressing (IPv4, IPv6), and network applications and services (such as DNS, HTTP, peer-to-peer networks, web servers, VPN, openSSL.)

CSIS 223 NETWORK CONFIGURATION AND PROGRAMMING 3.0: 3 cr. E

This course provides a foundation of network administration including account administration, resource allocation and optimization, and service management. Strategies for maintaining robust and secure networks are explored. Topics include, but are not limited to: Network administration and configuration, network management (SNMP), network security, access controls, error correction, routing protocols, congestion control (TCP, UDP), selection of topics including DHCP, ICMP, VPNs, and multicast. Programming assignments include developing client and server software using sockets, RMI or CORBA.

Pre-requisite: CSIS 222.

CSIS 230 INTRODUCTION TO CONCURRENT AND DISTRIBUTED PROCESSING 3.0: 3 cr. E

Design and analysis of concurrent programs with emphasis on those used for parallel and distributed processing. Mutual exclusion and deadlock detection. Communication and synchronization. Computational models: shared memory and message passing.

Pre-requisite: CSIS 220.

CSIS 231 JAVA TECHNOLOGY 3.0: 3 cr. E

This course introduces Java as a technology and a development and deployment platform (J2SE). It provides students with the skills to create applications that leverage the object-oriented features of Java, such as encapsulation, inheritance, and polymorphism. The course introduces students to GUI programming, multithreading, networking, and event-driven programming using Java technology GUI components. Students will develop classes to connect to SQL database systems by using the core aspects of JDBC API. Other topics include: Exception handling, multi-threading, RMI, two-tier and three-tier Java technology applications.

Pre-requisite: CSIS 215.

CSIS 232 ELECTRONIC COMMERCE 3.0: 3 cr. E

The use of multimedia and the web for commercial applications is a vital opportunity. The course highlights the major areas of applications by selecting and analyzing real life examples. Students manipulate and design web pages using standard software packages.

Pre-requisite: CSIS 270.

CSIS 235 MOBILE PROGRAMMING 3.0: 3 cr. E

Mobile computing is a growing developed communication system in distributed networks. It is a part of Human-Computer Interaction where users interact with portable mobile devices. This course covers the fundamental concepts of mobile computing including mobile area overview, concentrations on problems and solutions in mobile networking, mobility and data management, service management, and security for mobile and wireless communication systems. Topics include mobile communication, protocols and data format, mobile devices and components, data and service management, characteristics of mobile applications, and security in mobile computing environments.

Pre-requisite: CSIS 215.

CSIS 240 SEMANTICS OF PROGRAMMING LANGUAGES 3.0: 3 cr. E

Methods of defining programming language semantics: axiomatic, denotational, and operational semantics.

Pre-requisite: CSIS 216.

CSIS 245 SEMINAR IN COMPUTER PROGRAMMING 3.0: 3 cr. E

This course is a recollection of the foundation of computing and algorithmic principles, programming life cycle, procedural programming and object-oriented programming, abstraction, objects and classes, decision constructs and repetition structures.

CSIS 246 SURVEY OF TELECOMMUNICATIONS AND COMPUTER NETWORKS 3.0: 3 cr. E

This course presents network principles and design. Topics include: Basic concepts and terminology of computer networks, networking models and theory, networking protocols, LAN, WAN, MAN, wireless and mobile network technologies, network performance, network security, layers of the Internet Protocol Suite (the TCP/IP family of protocols), Internet addressing (IPv4, IPv6), and network applications and services (such as DNS, HTTP, peer-to-peer networks, web servers, VPN, openSSL.)

CSIS 247 SURVEY OF DATABASE SYSTEMS AND TECHNOLOGIES 3.0: 3 cr. E

The course covers the steps in building health information systems: analysis, design and implementation. Emphasis is placed on creating and manipulating databases: concept of data, DBMS architecture, schema and sub-schema, database system life cycles, normalization, security, integrity, and concurrency. Database technologies and applications are emphasized in lab work and projects.

CSIS 250 COMPUTER GRAPHICS 3.0: 3 cr. E

An introduction to computer graphics. The PHIGS and GKS graphics standards; geometrical transformation in 2D and 3D; viewing in 3D; projection; representing curves and surfaces; visible surface determination; advanced modeling techniques (factual models, spline, Bezier); color theory, realism, and rendering; elimination and shading.

Pre-requisite: CSIS 215, MATH 200.

CSIS 251 COMPUTER GRAPHICS DESIGN I 3.0: 3 cr. E

The student learns how to produce different kinds of advertising art, technical drawing, book illustration, and map production. Topics covered include: drawing, transformations, layers, color palette, 3D drawing, perspective, light, rendering, and texture.

CSIS 252 COMPUTER GRAPHICS DESIGN II 3.0: 3 cr. E

This course shows how professional artists use computer software (such as Photoshop or Painter) to manipulate, edit, and enhance scanned images to create a variety of special effects using artistic filters (such as KAI's power tools plug-in filter). Topics covered include: image editing, image enhancement, layers, construction of color palette, image mode (RGB, CMY,) light effects, transparency, mask, brushes, texture, and morphing.

CSIS 253 COMPUTER GRAPHICS DESIGN III 3.0: 3 cr. E

This course permits students to acquire a good knowledge of multimedia technologies. The student learns through practical projects to edit and produce video clip with sound and animation. Topics include video morphing (dynamic imaging). The student studies the programming language LINGO for Macromedia Director to make the projects truly interactive. (Adobe Premiere will be available for these projects).

Pre-requisites: CSIS 251/252.

CSIS 260 INTRODUCTION TO ARTIFICIAL INTELLIGENCE 3.0: 3 cr. E

Overview of methods used in Artificial Intelligence selected from knowledge representation, search techniques, theorem proving, expert systems, and natural language understanding.
Pre-requisite : CSIS 231.

CSIS 270 DATABASES 3.0: 3 cr. E

Data, DBMS architecture, schema and sub-schema, levels of data representation, database system life cycles. Relations within database architecture. Decomposition, normalization, hierarchy, and network. Data description language (DDL). Data manipulation language (DML); query languages and query optimization in centralization systems. Database security, integrity, and concurrency.

CSIS 271 DATABASE TECHNOLOGIES **3.0: 3 cr. E**

The course is designed as a second undergraduate course in databases. It is intended to cover both theory and application issues. Emphasis is placed on implementation more than design. Topics included: Database servers, transaction definition and properties, concurrency control, buffer management, reliability, query optimization, distributed architectures, and interoperability.

Pre-requisite: CSIS 270.

CSIS 272 DATABASE SYSTEMS MANAGEMENT **3.0: 3 cr. E**

The course is an advanced one in database technologies and a continuation of the course dealing with database design. Topics included are: Storage and file structure, indexing and hashing, query processing, transaction concept, concurrency control, and recovery systems. Open only for seniors.

Pre-requisite: CSIS 270.

CSIS 273 PERSONAL COMPUTING FOR APPLIED SCIENCES **3.0: 3 cr. E**

This course helps the student become a power user of several software packages used in daily problem solving. Topics covered include: personal productivity tools, statistical software for data analysis, database querying and Internet use. The course employs a combination of lecture-based delivery of material and experimental hands-on problem solving workshops.

CSIS 274 END USER COMPUTING **3.0: 3 cr. E**

This course helps the student become a power user of several software packages used in business problem solving. Topics covered include: personal productivity tools, what-if analysis, business charting and graphing, Internet browsing, and web page creation and maintenance. The course employs a combination of lecture-based delivery of material and experimental hands-on problem solving workshops.

CSIS 276 SYSTEMS ANALYSIS & DESIGN **3.0: 3 cr. E**

Analysis concepts (fact-finding, interview, feasibility study, user requirements, structured system analysis, documentation). Design concepts (design of I/O, file specification, database, algorithms, software and hardware specifications). Project management. Practical applications. Schedule and cost.

Pre-requisite: CSIS 270.

CSIS 277 INFORMATION SYSTEMS MANAGEMENT **3.0: 3 cr. E**

The course is an advanced study in Information Systems requiring a solid background in systems analysis and design, and information technology. Professional issues are treated at both theoretical and practical levels. Topics covered: the managerial functions, the role of information, its sources and pricing, project management, IT sourcing, TQM in Information Systems management, IT role in organizational change. Project management.

Pre-requisite: CSIS 276.

CSIS 278 SOFTWARE ENGINEERING AND QUALITY ASSURANCE **3.0: 3 cr. E**

The course covers methods and tools for achieving software quality assurance at various levels of a software system including at the module, subsystem, and system levels. State of the art tools and techniques are covered. The course will prepare students to develop a software quality assurance program in structured, organized ways.

Pre-requisite: CSIS 276.

CSIS 279 ADVANCES IN COMPUTER SCIENCE **3.0: 3 cr. E**

The course exposes students to software design, analysis and implementation abilities trough working with innovative tools and methodologies in an emerging area of high importance. Course content is revised and topics are selected on a yearly basis.

Pre-requisite : CSIS 231.

CSIS 280 INTRODUCTION TO THE THEORY OF COMPUTATION **3.0: 3 cr. E**

This course introduces the basics of the theory of computation. Topics covered include: automata theory and formal languages, computability by Turing machines and recursive functions, computational complexity, and mathematical logic.
Pre-requisite: CSIS 200.

CSIS 285 BASIC PROGRAMMING LAB **0.1.5: 1 cr. E**

The basic programming lab introduces students to features of the programming environment, to demonstrate coding and debugging techniques, and to implement example programs demonstrating concepts introduced earlier in the Introduction to Computing course (CSIS200).
Co-requisite: CSIS 200.

CSIS 286 OBJECT ORIENTED PROGRAMMING LAB **0.1.5: 1 cr. E**

Lab sessions are dedicated to students to work individually implementing the algorithms and codes already handled in the exercise sessions. The lab is to enable the students to master the techniques of problem solving and then writing efficient programs for those problems. Equal emphasis is placed on both the abstract and concrete versions of a concept so that the students learn about the concept itself and its implementation and application.
Co-requisite: CSIS 215.

CSIS 287 DATA STRUCTURE LAB **0.1.5: 1 cr. E**

The Data Structure Lab is to be taken simultaneously with the Data Structure course (CSIS 216) and it aims at making students competent in handling abstract concepts, using those concepts in problem solving, and then making these abstractions concrete using a programming language.

Co-requisite: CSIS 216.

CSIS 288 MOBILE PROGRAMMING LAB **0.1.5: 1 cr. E**

The Mobile Programming Lab focuses on teaching the details of the implementation of the front end of a complex handheld application involving the concepts presented in CSIS 235. Students will gain practical knowledge of the platforms, development environment, application fundamentals and the activity lifecycle and reconfiguration.

Co-requisite: CSIS 235.

CSIS 290 SENIOR PROJECT **3.0: 3 cr. E**

The purpose of the course is to provide an opportunity to finish a project under the direct supervision of a faculty member. The project should cover the practical aspect of a research and its design from conception through implementation and testing. Students meet regularly with the instructor to track technical and project management issues. Complete project documentation, written reports and oral presentations are required.
Pre-requisite: Advisor consent.

CSIS 295 DIRECTED STUDY IN DATABASES **1.5.0: 1 cr. E**

The course's aim is to develop in students their mastery of new database technologies, and their ability to independently update their knowledge and its applications (forms, reports…). Tutorials on one specific database area, taking into consideration the new developments in technology, and lab notes will be provided by the Department. The course supervisor assigns weekly meetings with the students for follow up.

Pre-requisite: CSIS 271.

CSIS 296 DIRECTED STUDY IN NETWORKING **1.5.0: 1 cr. E**

The course's aim is to develop in students their mastery of new techniques and methods in networking and

their applications. Tutorials and lab notes are provided by the Department. A supervisor is assigned for the course. The content might vary from one semester to another, taking into consideration the new developments in technology. The students and the supervisor meet once a week for follow up.

Pre-requisite: CSIS 222.

CSIS 297 DIRECTED STUDY IN PROGRAMMING **1.5.0: 1 cr. E**

The course's aim is to develop in students their ability to independently update their knowledge through tutorials and lab notes. A supervisor is assigned for the course. The offered language is selected by the Department taking into consideration the market demand. The students and the supervisor meet once a week for follow up.

Pre-requisite: CSIS 217.

CSIS 298 SEMINARS IN COMPUTING **1.5.0: 1 cr. E**

This course provides an opportunity to meet with experts or people working on new developments in the computing field. Upon completion, students should be able to demonstrate an understanding of a specific area of study through a project, paper and a presentation.

Pre-requisite: Senior standing and advisor consent.

ACCT 202, BUSN 230, 322, ECON 201, 211, 212, FINE 220.

Refer to the Faculty of Business and Management.

CSPR 201, 202, 203, 204

Refer to the Civilization Sequence Program.

ENGL 203, 204

Refer to the Division of English Language and Literature.

MATH 200, 201, 211, 230, 240, 246, 261.

Refer to the Department of Mathematics.

DEPARTMENT OF ENVIRONMENTAL SCIENCES

The Department of Environmental Sciences offers a Bachelor of Science (B.Sc.) degree to students who have successfully completed a minimum of **97 credits** of required courses provided that they satisfy the standards set by the University and the Faculty.

Program Mission:

The Department of Environmental Sciences trains students to understand the scientific basis of the environmental crisis, as well as the social, political and economic factors that affect environmental problems and solutions. The essence is to provide students with the scientific foundation, and the holistic critical thinking skills to better understand and manage environmental issues. The department fulfills the growing need for wise environmental management in this region, and, due to its unique combination of offering instruction and conducting research in numerous scientific areas; the department further promotes cooperation and exchange among traditional disciplines and faculties that share similar methodological and philosophical problems.

Program Learning Objectives:

The Bachelor of Science degree in Environmental Sciences aims to:

1. Provide students with the scientific foundation to understand the principles governing life and the interactions between living organisms and their surroundings
2. Train students to sample and to monitor environmental conditions using both modern and traditional technology
3. Develop students' natural resources management skills
4. Instill in students life-long learning habits and scholarly inquiry so that they become leaders in their discipline
5. Build the students' oral communication and scientific writing skills
6. Prepare students for employment or graduate studies by gaining hands-on work experience in environmental issues.

Program Learning Outcomes:

Upon graduation with a Bachelor of Science in Environmental Sciences, students will be able to:

1. Identify and explain environmental processes and human - environment interactions
2. Apply interdisciplinary perspectives and approaches to environmental problems
3. Use various instruments, software and techniques to analyze, sample and monitor environmental conditions
4. Critically assess and evaluate environmental problems at a local and global scale
5. Devise and implement management strategies for various natural resources
6. Draft professional reports, including description, analysis and recommendations for environmental issues
7. Design effective oral presentations and scientific papers.

To graduate with a B.Sc. in Environmental Sciences, students must complete the following:

I. 50 credits of Major Courses

BIOL 201, 202, 203, 204, 207, 208, CHEM 202, 203, 292, EVSC 201, 207, 211, 213, 233, 239, 241, 242, 243, 245, 249.

II. 19 credits of Department-Required Courses

CHEM 240, CSIS 273, MATH 203, 242, 272, PHYS 211, 212.

III. 19 credits of University-Required Courses

ENGL 203, 204, CSPR 201, 202, 203, 204, LISP 200.

IV. 09 credits of Elective Courses

BACHELOR OF SCIENCE IN ENVIRONMENTAL SCIENCES

SEMESTER 1

Code	Course Title	Credit
BIOL 201	General Biology I	3
BIOL 202	General Biology I Lab	1
CHEM 202	Basic Chemistry	3
CHEM 203	Basic Chemistry Lab	1
CSIS 273	Personal Computer for Applied Sciences	3
ENGL 203	English Communication Skills III	3
MATH 203	Mathematics for Applied Sciences	3
LISP 200	Library Use and Research Methods	1
Total		**18**

SEMESTER 2

Code	Course Title	Credit
BIOL 203	General Biology II	3
BIOL 204	General Biology II Lab	1
BIOL 207	General Ecology	3
BIOL 208	General Ecology Lab	1
CSPR 201	Civilization and Relegion	3
ENGL 204	English Communication Skills IV	3
EVSC 201	Environmental Sciences: Creating a Sustainable Future	3
Total		**17**

SEMESTER 3

Code	Course Title	Credit
CHEM 240	Basic Organic Chemistry	3
EVSC 213	Restoration and Reclamation Ecology	3
EVSC 249	Writing for Environmental Professionals	3
MATH 272	Differential Equations for Applied Sciences	3
PHYS 211	Fundamentals of Physics I	3
PHYS 212	Fundamentals of Physics I Lab	1
Total		**16**

SEMESTER 4

Code	Course Title	Credit
CHEM 292	Environmental Chemistry	3
EVSC 245	Marine Ecosystems	3
EVSC 233	Pollution Sources and Transport in Ecosystems	3

CSPR 202	Philosophy and Culture	3
MATH 242	Statistics for Applied Sciences	3
Total		**15**

SUMMER SEMESTER

Code	Course Title	Credit
EVSC 211	Project Residency	3
Total		**3**

SEMESTER 5

Code	Course Title	Credit
EVSC 207	Coastal Zone Management	3
EVSC 239	Environmental Economics and Development	3
CSPR 203	Cultures and Society	3
	Electives	6
Total		**15**

SEMESTER 6

Code	Course Title	Credit
CSPR 204	Arabic Thought and Culture	3
EVSC 241	Natural Resources Planning and Policy	3
EVSC 242	Natural Resources Planning and Policy Lab	1
EVSC 243	Special Topics for Environmental Sciences	3
	Electives	3
Total		**13**

Total credits **97**

ENVIRONMENTAL SCIENCE ELECTIVE COURSES

I- Within the Department

Code	Course Title	Credit
EVSC 221	Assessment and Management of Fish Populations	3
EVSC 222	Assessment and Management of Fish Populations Lab	1
EVSC 219	Wildlife Resources Management	3
EVSC 247	Environmental Risk Perception	3
EVSC 251	Protected Areas Management and Planning	3
EVSC 209	Introduction to Aquaculture	3
EVSC 235	Environmental Communication Approaches	3
EVSC 237	Ecotourisim Planning and Development	3

II- Premedical Track

Students wishing to follow the Premedical track are requested to register for the following as electives:

Code	Course Title	Credit
CHEM 242*	Organic Chemistry I	3

CHEM 244*	Organic Chemistry II	3
CHEM 222	Analytical Chemistry or equivalent	3
PHYS 213	Fundamentals of Physics II	3
PHYS 214	Fundamentals of Physics II Lab	1

* Replace CHEM 240 (refer to the Department of Chemistry)

Students will have to register for three additional credits to the required number for the BS in Environmental Sciences.

Minor in Environmental Sciences

The Department of Environmental Sciences offers a Minor available to all Faculties at the University. This minor presents students the opportunity to focus on a growing national and international issue by taking only 18 credits at the Department. In addition to the 4 mandatory courses, students may choose between any of the remaining EVSC courses for completing the requirements for the Minor.

Refer to the table below for details.

Environmental Sciences Courses	Credit	Mandatory	Electives
EVSC 201: Creating a Sustainable Future	3	X	
EVSC 207: Coastal Zone Management	3		X
EVSC 209: Introduction to Aquaculture	3		X
EVSC 211: Project Residency	3		X
EVSC 213: Restoration and Reclamation Ecology	3		X
EVSC 219: Wildlife Resources Management	3		X
EVSC 221: Assessment and Management of Fish Populations	3		X
EVSC 222: Assessment and Management of Fish Populations Lab	1		X
EVSC 233: Pollution Sources and Transport in Ecosystems	3	X	
EVSC 235: Environmental Communication Approaches	3		X
EVSC 237: Ecotourism Planning and Development	3		X
EVSC 239: Environmental Economics and Development	3		X
EVSC 241: Natural Resources Planning and Policy	3	X	
EVSC 243: Special Topics for Environmental Sciences	3	X	
EVSC 245: Marine Ecosystems	3		X
EVSC 246: Marine Ecosystems Lab	1		X
EVSC 247: Environmental Risk Perception	3		X
EVSC 249: Writing for Environmental Professionals	3		X
EVSC 251: Protected Areas Management and Planning	3		X

COURSE DESCRIPTIONS

EVSC 100 INTRODUCTION TO ENVIRONMENTAL SCIENCE **3.0: 3 cr. E**

This course will introduce the principles of basic-science and technology involved in processes of environmental change, pollution and protection of natural resources, and their implications to economic and human systems. (For Freshman students only).

EVSC 200 INTRODUCTION TO ENVIRONMENTAL STUDIES 3.1: 1 cr. E

The course introduces the student to the natural environment as it relates to people's lives. Aspects of the natural environment such as relationships between living and non living elements are discussed. The course also looks into environmental degradation and causes of pollution as well as ways to control them. The course will expose students to practical knowledge on environmental conversation which they will use in their daily lives as the course emphasizes the role of individuals in this area.

EVSC 201 ENVIRONMENTAL SCIENCES: CREATING A SUSTAINABLE FUTURE 3.0: 3 cr. E

This course introduces students to the root causes of the environmental crisis, explains how to critically analyze all of the issues and competing viewpoints, provides in depth case studies and the latest statistics and scientific findings within the field. It examines the interactions between humans, social systems, and environmental damage across the globe, emphasizes the need for fundamental changes in human behavior and shows how systems can be redesigned to be sustainable.

Co-requisite: BIOL 207.

EVSC 203 THE NATURE OF EARTH: EXPLORING GEOLOGY 3.0: 3 cr. E

The course presents an overview of the evolution of Earth and the major processes that shaped it. It also addresses the occurence and distribution of strong natural phenomena including earthquakes, volcanos, landslides as well as the formation or disappearance of mountains. Topics also include various types of rocks, soils and climate patterns.

EVSC 204 GEOLOGY LABORATORY 3.0: 1 cr. E

The laboratory course investigates rock types and geological features. it also includes site visits to specialized laboratories and areas of high geological intrest.

EVSC 207 COASTAL ZONE MANAGEMENT 3.0: 3 cr. E

This course introduces the student to a wide range of coastal environments including studies on rocky and sandy beaches. The course mixes theory and practice of coastal planning and management and demonstrates the importance of combining abstract and technical elements to achieve the best outcome for the coastal zone. Case studies will show examples of sound practice and differences in approaches around the world as well as the linkage between scales of coastal planning.

Pre-requisite: BIOL 207.

EVSC 209 INTRODUCTION TO AQUACULTURE 3.0: 3 cr. E

This course introduces the history of Aquaculture and its importance. Covers the fundamentals of engineering, nutrition, husbandry, diseases of cultured fishes and management of fish farms.

EVSC 211 PROJECT RESIDENCY 3.0: 3 cr. E

This course provides students with practical experience through their participation in on-going projects at organizations or institutions working in the fields of environment and development. Students are required to complete their residency over a period of two months under the supervision of a Faculty member.

EVSC 213 RESTORATION AND RECLAMATION ECOLOGY 3.0: 3 cr. E

Theory and case studies of disturbances, restoration and reclamation; character and processes of ecological systems; types of natural systems; types of disturbance and their impact; restoration and reclamation strategies for forests, deserts, watersheds, riparian zones, streams and rivers.

Pre-requisite: BIOL 207.

EVSC 219 WILDLIFE RESOURCES MANAGEMENT 3.0: 3 cr. E

This course provides a study of the ecological principles governing wild animal populations and their habitats and the relationship of these principles to management programs and decisions. This course will introduce techniques that can be used at the different levels of wildlife management: field, regional, national, international.

Pre-requisite: BIOL 207.

EVSC 221 ASSESSMENT AND MANAGEMENT OF FISH POPULATIONS 3.0: 3 cr. E

This course introduces the theory and methods for estimating vital statistics of fish populations, the use of computers and statistical software to describe, analyze, and model attributes of fish populations, applied aquatic and fish ecology related to fisheries, the role of planning in fisheries management and the application of management tools and assessment of their efficacy.

EVSC 222 ASSESSMENT AND MANAGEMENT OF FISH POPULATIONS LAB 0.3: 1 cr. E

Laboratory sessions include giving the students hands on experience with different fishing techniques, tagging studies and fish population sampling. Involves ½ day field trips out at sea.

Co-requisite: EVSC 221.

EVSC 233 POLLUTION SOURCES AND TRANSPORT IN ECOSYSTEMS 3.0: 3 cr. E

This course introduces students to the different sources of pollutions and their means of transport in air, soil and water. Toxic action and fate of environmental pollutants, pollution control, eco-toxicological impact and standard testing methods will be covered.

Pre-requisite: EVSC 201.

EVSC 234 POLLUTION SOURCES AND TRANSPORT IN ECOSYSTEMS LAB 0.3: 1 cr. E

Laboratory sessions and field trips to appropriate locations where the theoretical information can be consolidated into practical knowledge.

Co-requisite: EVSC 233.

EVSC 235 ENVIRONMENTAL COMMUNICATION APPROACHES 3.0: 3 cr. E

This course is based on cooperative learning activities. Students will learn how to organize environmental workshops and will get introduced to the theories and skills of alternative dispute resolution approaches, citizen participation strategies, public participation structures and dynamics, public policy decision making and implementation, risk communication, leadership styles and small group dynamics.

EVSC 237 ECOTOURISM PLANNING AND DEVELOPMENT 3.0: 3 cr. E

This course offers students a study of the fundamental concepts of nature based tourism planning and its contribution to community development. The course emphasizes the negative and positive economic, social, and environmental impacts of nature based tourism.

EVSC 239 ENVIRONMENTAL ECONOMICS AND DEVELOPMENT 3.0: 3 cr. E

Significant environmental destruction is caused by insufficient and incorrect attention to economics. Examples include subsidized prices for natural resources, neglect of external costs and benefits, and an excessive commitment to GNP growth and its neglect of the biophysical system in which the economy is embedded. In this class, students will be introduced to basic micro- and macroeconomics, distribution and trade, and the application of economic and social science principles and techniques to production, consumption, and valuation of natural resources. Students will also study differences between standard economists and the more interdisciplinary ecological economists.

EVSC 241 NATURAL RESOURCES PLANNING AND POLICY 3.0: 3 cr. E

Students will study scientific, environmental, social and institutional factors affecting planning and policy

making, with a focus on community-based natural resource management. The course focuses on ecosystem-based planning and policy issues through development of a multiple-use plan. Sources and use of environmental data are discussed and illustrated. A general overview of environmental laws on the national scale will be attempted.

Pre-requisites: EVSC 201, 239.

EVSC 242 NATURAL RESOURCES PLANNING AND POLICY LAB **1.0: 1 cr. E**
This course focuses on the applications of remote sensing, forest fire management and policy tools.
Co-requisite: EVSC 241.

EVSC 243 SPECIAL TOPICS FOR ENVIRONMENTAL SCIENCES **3.0: 3 cr. E**
This course introduces students to the new and current topics in the environmental sciences. Sessions will include exposure to environmental impact assessment methodologies, GIS systems, remote sensing and modeling and their applications to the environmental sciences and decision making. An overview of Lebanese environmental laws, policies and legal processes will also be covered.

Pre-requisite: EVSC 201.

EVSC 245 MARINE ECOSYSTEMS **3.0: 3 cr. E**
The course will present a broad overview of the field of marine biology. It will introduce the student to the marine environment, the physical forces governing marine organisms, the different marine ecosystems, the diversity of marine life, and techniques of investigation of marine systems.

Pre-requisite: BIOL 207.

EVSC 246 MARINE ECOSYSTEMS LAB **0.3: 1 cr. E**
This lab will provide students with hands-on experience in gathering and analyzing field data on marine ecosystems, and in gaining skills using a range of research tools and techniques.

Co- requisite: EVSC 245.

EVSC 247 ENVIRONMENTAL RISK PERCEPTION **3.0: 3 cr. E**
Concepts, problems, and research related to the assessment and management of environmental hazards, current psychological, sociological and cultural theories in risk perception, communication and policy. Emphasis will be placed on the interplay between science, politics, law, cultural values and public opinion.

EVSC 249 WRITING FOR ENVIRONMENTAL PROFESSIONALS **3.0: 3 cr. E**
This course introduces students to the principles and practice of writing skills required of environmental professionals. Students will develop proficiency in determining the purpose of a document, analyzing the audience; selecting, developing and organizing the information in an appropriate design, and writing clearly, precisely, and effectively.

Pre-requisite: ENGL 203.

EVSC 251 PROTECTED AREAS MANAGEMENT AND PLANNING **3.0: 3 cr. E**
This course introduces principles and methods of management of protected areas. Current principles and practices relevant to the planning of protected areas and recreational environments in wild settings. It includes the integration of biological and sociological criteria in the management of protected areas and recreational environments.

Pre-requisites: BIOL 207, and EVSC 201, 241.

BIOL 201, 202, 203, 204, 207, 208
Refer to the Department of Biology.

CHEM 202, 203, 240, 292

Refer to the Department of Chemistry.

CSPR 201, 202, 203, 204

Refer to the Civilization Sequence Program.

CSIS 273

Refer to the Department of Computer Science.

ENGL 203, 204

Refer to the Department of English Language and Literature.

MATH 203, 242, 272

Refer to the Department of Mathematics.

PHYS 211, 212

Refer to the Department of Physics.

DEPARTMENT OF MATHEMATICS

Objectives of the Program:

The Department of Mathematics offers a program leading to a Bachelor of Science in Mathematics. The program aims at:

1. Providing students with a robust and extensive background in mathematics.
2. Preparing students for graduate and further higher level studies.
3. Preparing students to pursue a profession in mathematics or mathematics education or careers in various industries where there is a demand for a rigorous understanding of mathematics or statistics.
4. Developing the student's ability to pursue knowledge independently by acquiring skills in problem solving, critical thinking, and logical analysis.
5. Enabling students to understand the power of mathematics and its role in human culture.
6. Emphasizing the close association of mathematics with the real world and its role in the fields of social sciences, physical and life sciences, engineering, and business.

The program of study leads to a Bachelor of Science in Mathematics with the following tracks:

1. General Mathematics
2. Applied Mathematics
3. Actuarial Science
4. Statistics

To qualify for a BS degree in Mathematics the student must complete a minimum of 91 credits. These include:

a- 31 credits in general University requirements

- 12 credits of the Civilization Sequence, namely CSPR 201, CSPR 202, CSPR 203, CSPR 204.
- 6 credits of English Language courses including ENGL 203 and another higher level English Language course.
- 12 credits in general elective courses chosen from within the Department of Mathematics or from outside the Department.
- 1credit Library use and Research Methods (LISP 200)- Free of Charge.

b- 21 credits in mandatory core courses (major courses), namely:

Course Code	Course Title	Credits
CSIS 206	Principles of Programming	3
MATH 200	Calculus I	3
MATH 202	Calculus II	3
MATH 211	Linear Algebra I	3
MATH 230	Numerical Analysis I	3
MATH 246	Probability	3
MATH 270	Differential Equations	3

c- 39 credits in major courses from the Department depending on the concentration track being pursued by the student.

CONCENTRATION TRACK COURSES

1-The General Mathematics Track

Program Objectives:

The objective of this track is to provide a strong mathematical background for students who are interested in pursuing a higher degree in mathematics or those who are interested in teaching mathematics at high school level.

To complete the BS program (The General Mathematics Track), the student must complete 39 credits: 33 obligatory credits and 6 elective credits.

Program Learning Outcomes:

Students graduating with a BS in Mathematics, General Mathematics Track, will be able to:

1. Solve problems using calculus, differential equations, algebra, geometry, and probability

2. Recognize what constitutes mathematical thinking, and produce and judge the validity of rigorous mathematical arguments

3. Communicate mathematical ideas, written and verbally, in a clear and organized way

4. Apply mathematical reasoning and use appropriate technology for the solution of mathematical problems and analysis of real world models.

Course Code	Course Title	Credits
MATH 205	Real Analysis	3
MATH 206	General Topology	3
MATH 208	Complex Analysis	3
MATH 210	Algebra	3
MATH 213	Linear Algebra II	3
MATH 241	Statistics I	3
MATH 261	Operations Research	3
MATH 271	Partial Differential Equations	3
MATH 281	Differential Geometry	3
MATH 282	Computational Geometry	3
PHYS 211	Fundamentals of Physics I	3

2 Major elective courses chosen from the list below

MATH 217	Ring and Modules Theory	3
MATH 243	Statistics II	3
MATH 260	Graph Theory	3
MATH 264	Game Theory & Decision Analysis	3
MATH 283	Geometry of Manifolds	3

2- The Applied Mathematics Track

Program Objectives:
This track is a professionally oriented program designed to provide opportunities for students to develop functional competence in mathematics and an appreciation for the contribution of mathematics to science and engineering. With this track, the department aims to prepare students to pursue graduate studies in mathematics or other related fields or embark on a career in industry or education.

Program Learning Outcomes:
Students graduating with a BS in Mathematics, Applied Mathematics Track, will be able to:
1. Manipulate and analyze data numerically and/or graphically
2. mathematical concepts and principles to perform computations and modeling
3. Communicate mathematical ideas, written and verbally, in a clear and organized way
4. Apply mathematical reasoning and use appropriate technology for the solution of mathematical problems and analysis of real world models.

Course Code	Course Title	Credits
MATH 205	Real Analysis	3
MATH 208	Complex Analysis	3
MATH 213	Linear Algebra II	3
MATH 215	Graph Theory	3
MATH 216	Algorithms and Data Structure	3
MATH 231	Numerical Analysis II	3
MATH 241	Statistics I	3
MATH 261	Operations Research	3
MATH 271	Partial Differential Equations	3
MATH 274	Calculus of Variation	3
MATH 299	BS Project or Major Elective	3
PHYS 211	Fundamentals of Physics I	3
PHYS 213	Fundamentals of Physics II	3

3- The Actuarial Science Track

An actuary is a financial expert who specializes in the mathematics and laws of the insurance industry. Actuaries need a strong background in mathematics in order to understand the behavior of insurance claims and investments. Most actuaries work for insurance companies, but others work in the public sector or in private consulting firms. Students trained as actuaries are also prepared for jobs as statisticians, demographers, and mathematicians.

Program Objectives:
Students following this track will have a solid educational background to take the actuary exams set by the Society of Actuaries (www.soa.org) which is a professional accrediting body in actuary mathematics. Students enrolled in the program will be ready to take Actuarial Exam I after the second year of study and Actuarial Exam II upon graduation. Students will also be prepared to take the more advanced actuarial exams.

Program Learning Outcomes :

Students graduating with a BS in Mathematics, Actuarial Science Track, will be able to:

1. Apply knowledge relevant to actuarial science in the areas of probability, financial mathematics, economics, life contingencies, corporate finance, and statistics.

2. Demonstrate the ability to communicate the results of inductive quantitative analysis effectively.

3. Apply mathematical reasoning and use appropriate technology for the solution of mathematical problems and analysis of real world models.

Course Code	Course Title	Credits
MATH 241	Statistics I	3
MATH 243	Statistics II	3
MATH 251	Life Contingencies I	3
MATH 252	Life Contingencies II	3
MATH 254	Risk and Reserves in Casualty Insurance	3
MATH 255	Methods for Ratemaking	3
MATH 256	Actuarial Estimation Methods	3
MATH 261	Operations Research	3
MATH 262	Math for Finance	3
MATH 264	Game Theory and Decision Analysis	3
MATH 299	BS Project or Major Elective	3
ECON 211	Microeconomics	3
ECON 212	Macroeconomics	3

4-The Statistics Track

The world is becoming more and more quantitative. Many professions depend on numerical measurements to make decisions in the face of uncertainty. Statisticians use quantitative abilities, statistical knowledge, and communication skills to work on many challenging problems.

Program Objectives:

The BS in Statistics provides students with a sound understanding of statistical methods, their underlying theories, and their applications. It aims to prepare students for immediate work as statisticians in the public sector, industry, and research institutions. The program also aims to provide students with a good foundation in pursuing graduate studies in statistics or other related fields.

Program Learning Outcomes:

Students graduating with a BS in Mathematics, Statistics Track, will be able to:

1. Apply statistical reasoning, inferential methods and use appropriate technology for the solution of mathematical problems and analysis of real world models

2. Manipulate and analyze data numerically and/or graphically

3. Demonstrate the ability to communicate the results of inductive quantitative analysis effectively.

Course Code	Course Title	Credits
MATH 221	Graph Theory	3
MATH 241	Statistics I	3
MATH 243	Statistics II	3
MATH 244	Categorical Data Analysis	3
MATH 245	Stochastic Processes	3
MATH 249	Statistical Computing	3
MATH 251	Life Contingencies I	3
MATH 261	Operations Research	3
MATH 262	Math for Finance	3
MATH 264	Game Theory and Decision Analysis	3
MATH 265	Optimization	3
MATH 271	Partial Differential Equations	3
MATH 299	BS Project or Major Elective	3

Students majoring in Statistics can have a Biostatistics option by substituting the three general elective courses by the following courses: General Biology I (BIOL 201), General Biology II (BIOL 203), and Principles of Epidemiology and Biostatistics (FHSC 282), or equivalent courses.

COURSE DESCRIPTIONS

MATH 200 CALCULUS I **4.0: 3 cr. E**

This course covers the following topics: techniques of integration, definite and indefinite integrals, applications of definite integrals, sequences, infinite series, Fourier series, graph in polar coordinates, functions of several variables and double integrals.

MATH 201 MATHEMATICS FOR COMPUTATION **4.0: 4 cr. E**

This course covers the following topics: laws of logic, sets and relations, functions, induction and recursion, Boolean algebra, matrix algebra, solution of linear systems, power series, and functions of several variables.

MATH 202 CALCULUS II **4.0: 3 cr. E**

This course covers the following topics: multi-variable functions, multiple integrals, cylindrical and spherical coordinates, line integrals, surface area, circulation and flux, Green's theorem, Stokes theorem, Divergence theorem.

Pre-requisite: MATH 200.

MATH 203 MATHEMATICS FOR APPLIED SCIENCES **3.0: 3 cr. E**

This course covers the following topics: techniques of integrations, infinite series, polar coordinates, functions of several variables, partial derivatives, chain rule, and multiple integrals with applications.

MATH 204 ENGINEERING TOPICS IN MATHEMATICS **3.0: 3 cr. E**

This course covers some of the following topics: Multiple integrals, vector fields, Fourier series, Laplace transform, power series solutions of ODE, partial differential equations, numerical algorithms, finite difference calculus, interpolation and extrapolation, roots of equations, numerical solution of simultaneous linear algebraic equations, least-squares approximation, numerical integration, numerical solution of ordinary differential equations.

Pre-requisite: MATH 200.

MATH 205 REAL ANALYSIS **3.0: 3 cr. E**

This course covers the following topics: The real number system, sequences and subsequences, Cauchy sequences, supremum and infimum, accumulation points, pointwise and uniform convergence, limits, continuity of functions, open, closed, connected, compact of sets, differentiation and integration.
Pre-requisite: MATH 202.

MATH 206 GENERAL TOPOLOGY **3.0: 3 cr. E**

This course covers the following topics: Metric spaces, distances, diameters, equivalent metrics, Euclidian spaces. Topological spaces: open sets, accumulation points, closure and Neighborhood, bases and subbases for a topology, subspaces, products and quotients. Normed and Hilbert spaces, local connectedness, path connectedness, separation axioms, and completeness.
Pre-requisite: MATH 205.

MATH 207 SET THEORY **3.0: 3 cr. E**

This course covers the following topics: countable and uncountable sets, cardinality and cardinal arithmetics, the construction of the real numbers, the continuum hypothesis, transfinite numbers, the axiom of choice.
Pre-requisite: MATH 206.

MATH 208 COMPLEX ANALYSIS **3.0: 3 cr. E**

This course covers the following topics: complex numbers, analytic functions, derivatives, Cauchy-Reimann equations, complex integrations, Cauchy integral theorem, power series, Taylor and Laurent series, residue theorem, conformal mappings.
Pre-requisite: MATH 205.

MATH 210 ALGEBRA **3.0: 3 cr. E**

This course covers the following topics: Theory of groups, homomorphism, theory of rings, ideals, unique factorization, and theory of field.

MATH 211 LINEAR ALGEBRA I **3.0: 3 cr. E**

This course covers the following topics: linear systems, matrix operations, echelon form, vector spaces, linear transformations, determinants, eigenvalues and eigenvectors, diagonalization of matrices.

MATH 213 LINEAR ALGEBRA II **3.0: 3 cr. E**

This course covers the following topics: Reduction of matrices, eigenvalues and eigenvectors, diagonlization and triangulation of matrices and its applications. Minimum polynomials, characteristic subspaces. Bilinear and quadratic forms. Symmetric and Hermitian forms. Reduction of quadratic forms. Euclidian spaces, inner product, orthogonality, orthogonal projection.
Pre-requisite: MATH 211.

MATH 214 COMBINATORICS **3.0: 3 cr. E**

This course covers the following topics: permutations and combinations, counting principles, inclusion-exclusion, recurrence relations and generating functions, graphs and trees. Combinatorial designs and coding theory, combinatorial existence theorems.
Pre-requisites: MATH 200, 210.

MATH 215 GRAPH THEORY I **3.0: 3 cr. E**

This course covers the following topics: Paths, circuits, cuts, trees, chains, Euler graphs, matrix presentation, spanning trees, connectivity of a graph, Hamiltonian graphs, graph factorization. Planar graphs, external graph

theory, directed graphs, enumeration, algebraic graph theory, probabilistic graph theory, graph embedding, graph coloring problems and applications.

MATH 216 ALGORITHMS AND DATA STRUCTURE **3.0: 3 cr. E**

This course covers the following topics: concept of data structure algorithms-lists, graphs, rooted trees, heaps, and disjoint set structures, Greedy algorithm, probabilistic algorithm, dynamic programming, efficiency and complexity of algorithms.
Pre-requisites: MATH 215.

MATH 217 RINGS AND MODULES THEORY **3.0: 3 cr. E**

This course covers the following topics: Rings, ideals and homomorphisms, quotient rings, rings of fractions, polynomial rings, group rings. Modules, module homomorphisms, quotient modules, direct sums of modules, characteristic and minimal polynomials, rational and Jordan canonical forms, exact sequences, tensor products of modules.
Pre-requisites: MATH 211.

MATH 221 NUMBER THEORY **3.0: 3 cr. E**

This course covers the following topics: divisibility, congruences, arithmetic functions, Chinese remainder theorem, Fermat theorem, quadratic forms, quadratic reciprocity, Diophantine equations.
Pre-requisites: MATH 211.

MATH 230 NUMERICAL ANALYSIS I **3.0: 3 cr. E**

This course covers the following topics: finite difference calculus, interpolation and extrapolation, solution of systems of linear equations, root of equations, least square curve fitting, numerical integration, numerical solution of ordinary differential equations.
Pre-requisite: CSIS 206, MATH 200, 211.

MATH 231 NUMERICAL ANALYSIS II **3.0: 3 cr. E**

This course covers the following topics: finite elements methods, solution of elliptic, hyperbolic and parabolic equations, approximation, matrix representation, solution of non-linear systems, solution of non stationary systems, numerical methods to calculate eigenvalues and eigenvectors.
Pre-requisite: MATH 230, 271

MATH 240 PROBABILITY AND STATISTICS **4.0: 4 cr. E**

This course covers the following topics: introduction to descriptive statistics, random variables and probability distribution, mathematical expectation. Discrete probability distributions: uniform, binomial and multinomial, hyper-geometric, negative binomial, geometric and Poisson distributions. Continuous probability distribution: normal distribution, gamma and exponential distributions, χ^2 distribution.: Sampling theory, estimation theory, hypothesis tests.
Pre-requisite: MATH 200.

MATH 241 STATISTICS I **3.0: 3 cr. E**

This course covers the following topics: sampling theory, estimation of the mean, variance, and proportion parameters for one and two groups. Bayesian estimation, maximum likelihood estimation, hypothesis tests and significations.
Pre-requisites: MATH 246.

MATH 242 STATISTICS FOR APPLIED SCIENCES **3.0: 3 cr. E**

This course covers the following topics: sampling theory, estimation theory, confidence intervals, hypothesis

tests and significations, t test (student), F test (Fisher) and χ^2 test (Pearson), linear regressions, and correlation.

MATH 243 STATISTICS II **3.0: 3 cr. E**

This course covers the following topics: one and two-factor analysis of variance (ANOVA), regression and multiple regressions, nonparametric statistics, introduction to time series.

Pre-requisite: MATH 241.

MATH 244 CATEGORICAL DATA ANALYSIS **3.0: 3 cr. E**

This course covers the following topics: stratified data analysis, using model-building strategies, assessing the fit of a binary logistic regression model, and detecting interactions and nonlinear effects, two-way and three-way contingency tables, logistic regression, loglinear models for contingency tables, collapsibility, ordinal associations, multicategory logistic models.

MATH 245 STOCHASTIC PROCESSES **3.0: 3 cr. E**

This course covers the following topics: measure theoretic probability, martingales, filtration, and stopping theorems, elements of large deviations theory, Brownian motion and reflected Brownian motion, stochastic integration. In addition, the course will cover some applications to finance theory, insurance, queuing and inventory models.

MATH 246 PROBABILITY **3.0: 3 cr. E**

This course covers the following topics: introduction to descriptive statistics, random variables and probability distribution, mathematical expectation. Discrete probability distributions: uniform, binomial and multinomial, hyper-geometric, negative binomial, geometric and Poisson distributions. Continuous probability distribution: normal distribution, gamma and exponential distributions, χ^2 distribution.

Pre-requisite: MATH 200.

MATH 249 STATISTICAL COMPUTING **3.0: 3 cr. E**

This course covers the following topics: Use of statistical software such as SAS, SPSS, and Statistica to help students better understand the theoretical results and give them a chance to apply the techniques to real world problems.

Pre-requisite: MATH 211.

MATH 251 LIFE CONTINGENCIES I **3.0: 3 cr. E**

This course covers the following topics: The mortality table, life annuities, pensions, life insurance premiums, reserves, cash value, loss premiums, dividends.

Pre-requisite: MATH 211.

MATH 252 LIFE CONTINGENCIES II **3.0: 3 cr. E**

This course covers the following topics: the measurement of mortality, life annuities, life insurance, net annual premiums, net level premium reserves, population theory, and special topics.

Pre-requisites: MATH 251.

MATH 254 RISK AND RESERVES IN CASUALTY INSURANCE **3.0: 3 cr. E**

This course covers the following topics: the economics of insurance, utility functions, utility and insurance, compound distribution of aggregate claims, premiums, loss and expense reserves, loss reserving methods, known claims, IBNR claims, all incurred claims.

Pre-requisite: MATH 243.

MATH 255 METHODS FOR RATEMAKING **3.0: 3 cr. E**

This course covers the following topics: full and partial credibility, Bayesian credibility, empirical Bayes credibility, claims frequency and claims severity, aggregate claim distributions, modeling loss distributions, application of distributional models, principles of ratemaking, data for ratemaking.

Pre-requisite: MATH 243.

MATH 256 ACTUARIAL ESTIMATION METHODS **3.0: 3 cr. E**

This course covers the following topics: measures of mortality and morbidity, fitting parametric survival distribution, mortality assumptions, individual record formula, practical aspects of mortality table construction.

Pre-requisites: MATH 243.

MATH 260 INTRODUCTION TO GRAPH THEORY **3.0: 3 cr. E**

This course covers the following topics: Graphs (Paths, circuits, cuts, …) and digraphs, trees and blocks, Hamiltonian graphs, matchings and Eulerian graphs, the coloring problem, planar graphs, complexity of algorithms, minimum spanning tree (MST) algorithm, single-source shortest-path algorithm, real-world applications.

MATH 261 OPERATIONS RESEARCH **3.0: 3 cr. E**

This course covers the following topics: General linear programming, the simplex method and sensitivity analysis, duality, network models including minimum spanning trees, the shortest route problem and CPM and PERT computations, deterministic and non-deterministic inventory methods.

MATH 262 MATHEMATICS FOR FINANCE **3.0: 3 cr. E**

This course covers the following topics: Fractional exponents and radicals, simple interest, compound interest and compound amount, compound discount and present value, simple annuities, effective annual rate of interest, amortization and equity, and sinking funds.

MATH 264 GAME THEORY & DECISION ANALYSIS **3.0: 3 cr. E**

This course covers the following topics: Matrix games, relation to linear programming, non-zero sum games, decision trees, models for group decisions, utility theory.

Pre-requisite: MATH 261.

MATH 265 OPTIMIZATION **3.0: 3 cr. E**

This course covers the following topics: Deterministic and probabilistic models, unconstrained optimization methods: one dimensional search, gradient, Newton, and conjugate direction, genetic algorithms, and nonlinear optimization.

Pre-requisite: MATH 261.

MATH 270 DIFFERENTIAL EQUATIONS **3.0: 3 cr. E**

This course covers the following topics: first, second and higher order ordinary differential equations, separable and exact first order equations, Bernoulli and Euler-Cauchy equations, undetermined coefficient, variation of parameters, power series solution, Laplace transform, and classification of partial differential equations.

Pre-requisite: MATH 200.

MATH 271 PARTIAL DIFFERENTIAL EQUATIONS **3.0: 3 cr. E**

This course covers the following topics: Linear partial differential equations, separation of variables method, calculus of Fourier series, heat equation, wave equation, Laplace equation, and Sturm-Liouville Eigenvalue problem.

Pre-requisites: MATH 202, 270.

MATH 272 DIFFERENTIAL EQUATIONS FOR APPLIED SCIENCES **3.0: 3 cr. E**

This course covers the following topics: first, second and higher order ordinary differential equations, separable and exact first order equations, Bernoulli and Euler-Cauchy equations, undetermined coefficient, variation of parameters, power series solution.

Pre-requisite: MATH 203.

MATH 274 CALCULUS OF VARIATIONS **3.0: 3 cr. E**

This course covers the following topics: variation of a functional, variational derivative, invariance of Euler's equation, variational problems in parametric form, the Weierstrass-Erdmann conditions, the canonical form of Euler equations, the Legendre transformation, the Hamilton-Jacobi equation, the second variation of a functional, the field of a functional, Hilbert invariant, and variational problems involving multiple integrals.

Pre-requisite: MATH 200.

MATH 280 FOUNDATIONS OF GEOMETRY **3.0: 3 cr. E**

This course covers the following topics: axiom systems, Euclidean geometry, parallel postulate, non-Euclidean geometry (elliptic, parabolic, and hyperbolic), affine geometry, projective geometry.

Pre-requisites: MATH 200.

MATH 281 DIFFERENTIAL GEOMETRY **3.0: 3 cr. E**

This course covers the following topics: curves in space, regular surfaces, tensors, the geometry of the Gauss map, normal curvature, the geometry of surfaces, Gauss-Bonnet theory.

Pre-requisite: MATH 202.

MATH 282 COMPUTATIONAL GEOMETRY I **3.0: 3 cr. E**

This course covers the following topics: Introduction to computer graphics, the PHIGS and GKS graphics standards, geometrical transformation in 2D and 3D, viewing in 3D, projection, representing curves and surfaces, visible surface determination, advanced modeling techniques (factual models, spline, Bezier), color theory, realism, rendering, elimination and shading.

Pre-requisite: CSIS 206, MATH 200, 211.

MATH 283 GEOMETRY OF MANIFOLDS **3.0: 3 cr. E**

This course covers the following topics: Manifolds, sub-manifolds, tangent vectors, vector fields, flows, tensor fields, differential forms, Riemannian metrics and their simple properties, application of 3-dimensional manifolds.

MATH 290 HISTORY OF MATHEMATICS **3.0: 3 cr. E**

This course covers the following topics: roots of modern mathematics in ancient Babylonia and Greece, early number systems, the development of arithmetic, geometry, algebra and analysis.

MATH 292 TECHNICAL PLATFORM COMPUTING **3.0: 3 cr. E**

This course covers the following topics: Symbolic manipulation, graphics, word-processing aspects, typesetting and programming, application to numerical analysis and graphics. Computer Algebra Systems such as Mathematica, Matlab or Maple are used.

Pre-requisite: MATH 230.

MATH 293 MATH TOPICS REVIEW **3.0: 3 cr. E**

This is a remedial course focusing on some of the following topics: Trigonometry, addition of trigonometric functions with same frequency but different phases and amplitudes, sketch the graph of functions, function of multiple variables, integration techniques including integration by part, derivatives of functions with single variable, second order linear ordinary differential equation (homogeneous & nonhomogeneous), determination of algebraic representation of periodic function through Fourier series, center of mass and moment of inertia computation, matrix algebra (determinant, inverse, addition, multiplication,….), computational skills.

MATH 299 BS PROJECT **3.0:3 cr E**

CSIS 206

Refer to the Department of Computer Science.

PHYS 211, 213

Refer to the Department of Physics.

BIOL 201, 203

Refer to the Department of Biology.

FHSC 282

Refer to the Faculty of Health Sciences.

ECON 211, 212

Refer to the Department of Economics.

CSPR 201, CSPR 202, CSPR 203, CSPR 204, ENGL 203, ENGL 204

Refer to Faculty of Arts and Social Science.

DEPARTMENT OF PHYSICS

The Faculty of Sciences at the University of Balamand offers both an undergraduate major and a minor in Physics. The B. Sc. in Physics covers the broad fundamentals necessary for graduate study in Physics and many related fields. The minor in Physics offers the basic courses that provide a firm background to accommodate the needs of interested students.

Program Objectives

1. Provide students with a broad, sound and extensive knowledge of the fundamental concepts of Physics
2. Gain an insight into physical phenomena and processes
3. Develop an understanding of the power of Physics to deal with problems related to technology and the environment
4. Qualitatively analyze and provide solutions to problems
5. Prepare students for teaching and/or research positions in colleges, universities, laboratories and research centers
6. Gain effective communication skills both verbally and in writing
7. Help students attain their full academic potential by encouraging them to be critically receptive to new ideas

Program Learning Outcomes

1. A thorough knowledge of the basic fields of physics, including mechanics, optics, relativity, electricity and magnetism, classical and quantum mechanics
2. A thorough knowledge of mathematics to facilitate the manipulation and description of physical problems
3. The ability to use this knowledge to assess and solve real physics problems
4. Demonstrate the ability to present clear and logical arguments
5. Develop efficient analytical thinking skills
6. Write and speak using professional norms
7. Organize and carry out long and complex physics problems and suggest reasonable solutions
8. Use basic laboratory data analysis techniques to represent data graphically and to assess it statistically by treating errors and uncertainties
9. Apply scientific and technical knowledge and skills to other disciplines and areas of study
10. Become aware of the impact of physics in social, economic, and environmental issues
11. Gain the motivation for life-long learning and research.

Major in Physics:

Students must successfully complete a minimum of 91 credits of required courses provided that they satisfy the standards set by the University of Balamand and the Faculty of Sciences. Students must complete the following:

A- 36 credits of Physics Courses

PHYS 201, 211, 212, 213, 214, 221, 223, 231, 233, 241, 243, 245, 261, 283.

B- 21 credits of Major Required Courses

CHEM 202, 222, CSIS 200, MATH 200, 202, 211, 270.

C- 19 credits of University Required Courses

ENGL203, ENGL 204, CSPR 201, CSPR 202, CSPR 203, CSPR 204, LISP 200.

D- 15 credits of Elective Courses

Can be taken within the Physics Department or from outside the Department.

N.B: Students seeking to fulfill Premedical requirements might use their elective credits to select the remaining MCAT-required courses not covered by the Physics B.Sc. curriculum, and totaling 16 credits. (See list of elective courses for details).

Minor in Physics:

The Faculty of Sciences offers a Minor in Physics for students who successfully complete a minimum of 15 credits of Physics courses as follows:

Course Code	Course Title	Credit
PHYS 201(1)	Instrumentation Laboratory	1
PHYS 211	Fundamentals of Physics I	3
PHYS 212	Fundamentals of Physics I Laboratory	1
PHYS 213	Fundamentals of Physics II	3
PHYS 214	Fundamentals of Physics II Laboratory	1

In addition to 2 courses offered by the Physics Department or their equivalent courses.

BACHELOR'S DEGREE

SEMESTER1

Course Code	Course Title	Credit
CSIS 200	Introduction to Computers & Programming	3
ENGL 203	English Communications Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra I	3
PHYS 211	Fundamentals of Physics I	3
PHYS 212	Fundamentals of Physics I Laboratory	1
Total		**16**

SEMESTER 2

Course Code	Course Title	Credit
CHEM202	Basic Chemistry	3
ENGL 204	English Communications Skills IV	3
MATH 202	Calculus II	3
PHYS 201(1)	Instrumentation Laboratory	1
PHYS 213	Fundamentals of Physics II	3
PHYS 214	Fundamentals of Physics II Laboratory	1
LISP 200	Library Use & Research Methods	1
Total		**15**

SEMESTER 3

Course Code	Course Title	Credit
CHEM 222	Analytical Chemistry I	3
CSPR 201	Civilization and Religion	3
MATH 270	Differential Equations	3
PHYS 221	Classical Mechanics	3
PHYS 241[3]	Electricity and Magnetism	3
Total		**15**

SEMESTER 4

Course Code	Course Title	Credit
CSPR 202	Philosophy and Culture	3
PHYS 223	Quantum Physics	3
PHYS 231[2]	Thermodynamics	3
PHYS 243[4]	Circuit Analysis I	3
	Elective	3
Total		**15**

SEMESTER 5

Course Code	Course Title	Credit
CSPR 203	Cultures and Society	3
PHYS 233	Thermal & Statistical Physics	3
PHYS 261	Special Relativity	3
	Elective (2)	6
Total		**15**

Course Code	Course Title	Credit
CSPR 204	Arabic Thought and Culture	3
PHYS 245	Modern Optics	3
PHYS 283	Nuclear Physics	3
	Electives (2)	6
Total		**15**

Total credits **91**

List of Electives

A- Within the Physics Department:

Course Code	Course Title	Credit
PHYS 235	Fluid Mechanics	3
PHYS 247	Photonics and Nonlinear Optics	3
PHYS 251	Introduction to Biophysics	3
PHYS 253	Introduction to Nanoscience	3
PHYS 263	Introduction to General Relativity	3
PHYS 271	Introduction to Solid State Physics	3
PHYS 281	Atomic and Molecular Physics	3

PHYS 285	Introduction to Particle Physics	3
PHYS 291	Computational Physics	3

B- From outside the Physics Department

i) Remaining Premedical courses:

Course Code	Course Title	Credit
BIOL 201	General Biology I	3
BIOL 202	General Biology Laboratory I	1
BIOL 203	General Biology II	3
BIOL 204	General Biology Laboratory II	1
CHEM 203	Basic Chemistry Laboratory	1
CHEM 242	Organic Chemistry I	3
CHEM 244	Organic Chemistry II	3
CHEM 245	Organic Chemistry Laboratory I	1

ii) Many courses from various other Departments at UOB

(1) PHYS 201- Instrumentation Laboratory is equivalent to ELEN 201
(2) PHYS 231- Thermodynamics is equivalent to MECH 232
(3) PHYS 241- Electricity and Magnetism is equivalent to ELEN 223
(4) PHYS 243- Circuit Analysis is equivalent to ELEN 221

COURSE DESCRIPTIONS

PHYS 001 SOP PHYSICS **3.0: 0 cr. E**

This course covers the basic concepts of mechanics within the context of the Newtonian theory, kinematics motion of a particle, dynamics, work and energy conservation, momentum conservation, circular motion, mechanical system in rational equilibrium, angular momentum conservation and direct alternating currents.

PHYS 100 INTRODUCTION TO PHYSICS I **3.0: 3 cr. E**

Physical quantities, standards and units. Vectors and scalars. Velocity and acceleration. Motion in one, two and three dimensions. Newton's laws, falling bodies, uniform circular motion. Work and energy, power, Kinetic energy theorem. Conservation of total energy. Rectilinear sinusoidal motion, angular sinusoidal motion. Linear and angular momentum collisions. Gravitation.

PHYS 102 INTRODUCTION TO PHYSICS II **3.0: 3 cr. E**

Fluids, statics, pressure, Pascal's principle and Archimede's Principle. Wave motion, interference of waves. Sound waves. Temperature, Kinetic theory, Brownian motion. Thermodynamics, first and second law. Alternating current, R-L-C circuits, power in A/C circuits. Light nature and propagation, reflection and refraction at plane surfaces. Spherical mirrors, interference of light. Diffraction, polarization, photoelectric effect, X-rays.

Pre-requisite: PHYS 100

PHYS 201 INSTRUMENTATION LABORATORY (Equivalent to ELEN 201) **0.3: 1 cr. E**

This laboratory provides an introduction on the use of multi-meters, oscilloscopes, function generators, power supplies and other instrumentation. Applications include solenoids, resistors, capacitors, periodic signals analysis, balanced bridge circuit, RC, RL and RLC circuits.

PHYS 211 FUNDAMENTALS OF PHYSICS I **3.0: 3 cr. E**

The course introduces some of the basic fundamentals of physics, including: kinematics of a particle, relative motion analysis, Newton's laws of motion, work, energy, center of mass, linear impulse and momentum, collision, torque, equilibrium, elasticity, gravity, properties of fluids, simple harmonic motion, transverse and longitudinal waves, resonance, sound waves, Doppler effect, thermal expansion, first and second laws of thermodynamics, entropy.

PHYS 212 FUNDAMENTALS OF PHYSICS I LABORATORY **0.3: 1 cr. E**

This laboratory introduces students to the types of basic apparatus used in physics. Experiments are designed to demonstrate the meaning and applications of the physical concepts included in the "Fundamental of Physics I" course.

Co-requisite: PHYS 211.

PHYS 213 FUNDAMENTALS OF PHYSICS II **3.0: 3 cr. E**

The course introduces some of the basic fundamentals of physics, including: electric charge, Coulomb's law, electrostatic force, electric field, electric potential, Gauss' Law, capacitors, capacitance, electric current, resistance, Ohm's law, power, emf, internal resistance, magnetic field, magnetic force, magnetic materials, alternating current, rms voltage and current, polarization, reflection, refraction, mirrors, thin lenses, interference, diffraction, photoelectric effect, blackbody radiation, hydrogen atom, fluorescence, atomic and mass numbers, isotopes, alpha, beta and gamma decays, nuclear fission, nuclear fusion.

PHYS 214 FUNDAMENTALS OF PHYSICS II LABORATORY **0.3: 1 cr. E**

This laboratory introduces students to the types of basic apparatus used in physics. Experiments are designed to demonstrate the meaning and applications of the physical concepts included in the "Fundamental of Physics II" course.

Co-requisite: PHYS 213.

PHYS 221 CLASSICAL MECHANICS **3.0: 3 cr. E**

This course deals with the fundamental principles of Classical Mechanics. It treats particle dynamics, the motion of systems of particles, rigid body motion, moving coordinate systems. Lagrange's equations, Hamilton's equations and small oscillations.

Prerequisite: PHYS 211 and MATH 202.

PHYS 223 QUANTUM PHYSICS **3.0: 3 cr. E**

The course describes the development of quantum physics; waves in classical physics, wave-packets, uncertainty principle, wave functions, operators, expectation values of dynamical observables; Schrödinger equation with application to one-dimensional problems, the hydrogen atom, electrons pin, periodic table; selected topics in perturbation theory, scattering theory.

Prerequisite: MATH 202 and MATH 270.

PHYS 231 THERMODYNAMICS (Equivalent to MECH 232) **3.0: 3 cr. E**

This is an introductory course which aims at providing students with theoretical background and the practical knowledge necessary to perform classical scientific and engineering analysis of basic open and closed thermodynamic systems.

PHYS 233 THERMAL AND STATISTICAL PHYSICS **3.0: 3 cr. E**

The laws of thermodynamics, elementary probability theory, kinetics theory of gases and Brownian motion, equilibrium, statistical mechanics of ideal systems: statistical origins of heat, temperature, entropy and equilibrium between phases.

Prerequisite: PHYS 231.

PHYS 235 FLUID MECHANICS **3.0: 3 cr. E**

The course introduces some of the basic fundamentals of fluid mechanics, including: pressure distribution; hydrostatic forces on surfaces; buoyancy; Reynolds transport theorem, conservation of mass, linear momentum equation, Bernoulli and energy equations; differential relations for fluid flow; fluid acceleration field, mass conservation, linear momentum and energy equations; stream function; vorticity and irrotationality; frictionless irrotational flows, principle of dimensional homogeneity, Pi theorem, non-dimensionalization of the basic equations; modelling and its pitfalls; viscous flow in ducts; Reynolds number regimes, head loss, friction factor, minor or local losses in pipe systems.

PHYS 241 ELECTRICITY AND MAGNETISM (Equivalent to ELEN 223) **3.0: 3 cr. E**

The course introduces some of the fundamentals of Electricity and Magnetism, including: Law of Coulomb, Electric Field, Charge Distribution, Line Charge, Streamlines, Electric Flux Density, Gauss' Law, Divergence, Maxwell's First Equation, Energy and Potential, Potential Gradient, Dipole, Energy Density , Conductors, Semiconductors, Dielectric Materials, Capacitance, Poisson's and Laplace's Equations, Biot-Savart Law, Ampere's Circuital Law, Stokes' Theorem, Magnetic Forces, Magnetic Materials, Permeability, Inductance, Faraday's Law.

Prerequisite: PHYS 201, MATH 200, 211.

PHYS 243 CIRCUIT ANALYSIS I (Equivalent to ELEN 221) **3.0: 3 cr. E**

The course introduces some of the fundamentals of Circuit Analysis, including: Current, Voltage, Conductors, Insulators, Semiconductors, Ammeters, Voltmeters, Resistance, Superconductors, Conductance, Ohmmeters, Thermistors, Photoconductive Cell, Ohm's Law, Power, Energy, Kirchhoff's Voltage Law, Kirchhoff's Current Law, Series-Parallel Networks, Mesh Analysis, Nodal Analysis, Thévenin's Theorem, Norton's Theorem, Millman's Theorem, Reciprocity Theorem, Capacitance, Dielectric Strength, Capacitors In Series And Parallel, Energy, Magnetic Fields, Flux Density, Permeability, Hysteresis, Ampère's Circuital Law, Faraday's Law, Lenz's Law, R-L-C Circuits.

Prerequisite: PHYS 201, MATH 200, 211.

PHYS 245 MODERN OPTICS **3.0: 3 cr. E**

This course covers the fundamental principles of modern physical optics and contemporary optical systems. Topics include propagation of light, polarization, coherence, interference, diffraction, Fourier optics, absorption, scattering, dispersion, and image quality analysis.
Prerequisite: MATH 202.

PHYS 247 PHOTONICS AND NONLINEAR OPTICS **3.0: 3 cr. E**

The first part of the course discusses the fundamentals and applications of photonics. The theory of guided wave optics is covered, including optical modes and their dispersion in rectangular and circular waveguides. Optical wave interaction with isotropic and anisotropic media is addressed. The second part deals with the fundamentals and applications of the nonlinear interaction of radiation with matter. Its goal is to give the student a working knowledge of nonlinear effects, nonlinear materials and the applications of nonlinear optics in various technologies.
Prerequisite: PHYS 245.

PHYS 251 INTRODUCTION TO BIOPHYSICS **3.0: 3 cr. E**

The course introduces some of the basic fundamentals of biophysics, including: heat and free energy, cell physiology, molecules and their sizes, probability in biophysics, ideal gas law, Brownian motion, diffusion and friction, Reynolds number, entropy, Boltzmann distribution, pressure and flow, chemical potential and reactions, elasticity, enzymes and molecular machines and nerve impulses.

PHYS 253 INTRODUCTION TO NANOSCIENCE **3.0: 3 cr. E**

This course will give students an introduction to nanoscience, which is a rapidly growing field in our society. The synthesis of nanomaterials, the tools used to characterize these materials, such as Electron Microscopy (SEM/TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM) and UV-Vis spectroscopy, and societal impacts of nanomaterials/technology (such as ethical, legal and environmental implications) will be covered. Students will select a nanomaterial of interest and also do a term paper and presentation.

PHYS 261 SPECIAL RELATIVITY **3.0: 3 cr. E**

The course introduces some of the fundamentals of Special Relativity, including: spacetime, inertial frame, observer, measuring particle speed, the principle of relativity, simultaneity, Lorentz contraction of length, invariance of the interval, twin paradox, worldline, stretch factor, causality, light cone, conservation of momenergy and its consequences, energy without mass: photon, spacetime curvature, black hole.

Prerequisite: PHYS 221.

PHYS 263 INTRODUCTION TO GENERAL RELATIVITY **3.0: 3 cr. E**

The course introduces some of the fundamentals of General Relativity, including: Lorentz Transformations, Tensors, Maxwell's Equations, Energy and Momentum, Manifold, Causality, Tensor Densities, Geodesics, Expanding Universe, Riemann Tensor, Killing Vectors, Einstein's Equation, Cosmological Constant, Geodesics of Schwarzschild, Singularities, Stars and Black Holes, Gauge Transformations, Gravitational Waves, Friedmann Equation, Redshifts, Gravitational Lensing, Inflation, Unruh Effect, Hawking Effect.

Prerequisite: PHYS 221, 261.

PHYS 271 INTRODUCTION TO SOLID STATE PHYSICS **3.0: 3 cr. E**

The course describes the basic theories of the properties of solids including electronic band structure of crystals, electrical conduction, optical properties, magnetism and superconductivity, crystal structure; lattice vibrations; thermal properties of solids; transport and other non-equilibrium phenomena in uniform and non-uniform materials.

Prerequisite: PHYS 223, 233 and 241.

PHYS 281 ATOMIC AND MOLECULAR PHYSICS **3.0: 3 cr. E**

The course introduces some of the basic fundamentals of atomic and molecular physics, including: Black body radiation, the photoelectric effect, atomic spectra, Schrodinger equation, energy levels, eigenfunctions, Einstein coefficients, Zeeman effect, Stark effect, Lamb shift, two-electron atoms, interaction with magnetic fields, molecular structure, nuclear spin, Born approximation, scattering, ionization and magnetic resonance.

Prerequisite: PHYS 223.

PHYS 283 NUCLEAR PHYSICS **3.0: 3 cr. E**

The course introduces some of the fundamentals of Nuclear Physics, including: Quantum Mechanics, Angular Momentum, Parity, Nuclear Radius, Abundance of Nuclides, Nuclear Binding Energy, Nuclear Force, Shell Model, Radioactive Decay Law, Counters, Detectors, Energy Measurements, Nuclear Lifetimes, Alpha Decay, Spectroscopy, Beta Decay, Fermi Theory, Forbidden Decays, Neutrino Physics, Gamma Decay, Nuclear Resonance Fluorescence, Neutron Sources, Nuclear Fission, Reactors, Nuclear Fusion, Solar Fusion.

Prerequisite: PHYS 223.

PHYS 285 INTRODUCTION TO PARTICLE PHYSICS **3.0: 3 cr. E**

The course introduces some of the fundamentals of Particle Physics, including: Leptons, Quark, Hadrons, Lorentz Transformations, Particle Probability, the Fock Operators, Maxwell Equations, Field Energy and Momentum, Boson Fields, Fermion Fields, Collisions and Decays, Parity, CPT Theorem, Mesons, Baryons, Gauge Field, Quantum Chromodynamics, Abelian Symmetry, Electroweak Interaction, Feynman Rules, CP Violation, Neutrinos, Effective Mass, Muon and Tau Lepton Decays, Gluon.

Prerequisite: PHYS 223.

PHYS 291 COMPUTATIONAL PHYSICS **3.0: 3 cr. E**

The course is an introduction to computationally based problem solving in physics, emphasis on understanding and applying various numerical algorithms to different types of physics problems. Topics will include chaos in mechanical systems, fractal structures, molecular dynamics and the properties of simple fluids, Monte Carlo methods, and time-dependent as well as time-independent problems in quantum mechanics.

Prerequisite: PHYS 221, 223, and CSIS 200.

CHEM 202, 222

Refer to Department of Chemistry.

CSPR 201, 202, 203, 204

Refer to Cultural Studies Program.

CSIS 200

Refer to the Department of Computer Science.

ENGL 203, 204

Refer to Department of English Language & Literature.

MATH 200, 202, 211, 270

Refer to Department of Mathematics.