FACULTY OF SCIENCE CATALOGUE

SEPTEMBER 2018

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A. University requirements
The University requirements (27 credit hours) are divided into compulsory courses (12 credit hours) and elective courses (15 credit hours)

I. Compulsory courses
Compulsory courses (12 credit hours) are shown in the table below:

Course Number	Course Title	Credit Hours
1714041118	National Education	3
1714041117	Military Sciences	3
121601101	Arabic Language	3
121602101	English Language	3

No prerequisites for the above mentioned courses

II. Elective courses
Elective courses (15 credit hours) are shown in the table below:

Course Number	Course Name	Credit Hours
110108104	Energy and its Sources	3
110108114	Automobile Essentials	3
110108130	Health and Nutrients	3
110108132	Sport and Health	3
111405102	Applied Arabic Language	3
111405112	Technical Translation	3
140108134	Ethics of Science	3
141603101	Italian Language	3
170108135	Reproductive Health	3
1714041102	Introduction to Psychology	3
1714041104	Family and Child Education	3
1714041110	Islam and Current Issues	3
1714041112	Jerusalem: History and Civilization	3
1714041114	History and Civilization of Jordan	3
1714041116	Archaeology and Tourism	3
1714041120	Economic and Management Science	3
1714041122	Principles of Sign Language	3
1714041126	Humanistic Moral and Values Education	3
1714041128	Cultural Heritage in Jordan	3
1714041194	Arabic Language and Current Issues	3
110108113	Biotechnology and Society	3
110108115	Computer Ethics	3
110108131	Health Education and First Aid	3
110108133	Environmental Awareness	3

111405111	Applied English Language	3
121603201	Spanish Language (1)	3
140108166	Medication Education	3
151603102	Japanese Language (Level 1)	3
1714041101	University Life of Student	3
1714041103	Life Skills	3
1714041107	Citizenship and Human Rights	3
1714041111	Islamic Thought	3
1714041113	Fundamentals of Art and Literature Aestheticism	3
1714041115	Sociology	3
1714041119	Leadership and Education	3
1714041121	Law and the Ordering of Our Life	3
1714041125	Entrepreneurship Principles	3
1714041127	Conflict Resolution and Accept others	3
1714041193	Palestinian Cause	3
1814041197	Selected Topics in National Trends	3

No prerequisites for the above mentioned courses

B- Faculty of Science
I. Introduction
Teaching in the Faculty started four years after the royal decree of establishing the Hashemite University in 1991. The Faculty was named "Faculty of Sciences and Arts". It included all the departments of the present "Faculty of Arts" and "Faculty of Science", in addition to computer science and geology. Biotechnology program was included to Department of Biology in the academic year 1999/2000. At the beginning of the academic year 2005/2006 the "Faculty of Sciences and Arts" was separated into two faculties: "Faculty of Science" and "Faculty of Arts". The faculty of Science consisted of four departments: Physics, Mathematics, Chemistry and Biology and Biotechnology. Finally, the Department of Basic Sciences was established and combined to the faculty in 2010/2011.

II. Numbers of students and faculty members
A total number of 5904 students (1260-males and 4644-females) had graduated from the "Faculty of Science" since its separation from the "Faculty of Arts" in 2005. The numbers of undergraduate (Bachelor's) and graduate (Master's) students are shown in the tables below:
- **Bachelor's students**

Mathematics	Physics	Chemistry	Biology	Biotechnology	Total No.
1480	1012	1431	951	794	5668

- **Master's students**

Physics	Chemistry	Biology	Total No.
76	69	91	236

For the academic year 2018/ 2019, the number of accepted students is 467 in the Bachelor's degree (141 males and 326 females) and 19 in the Master's degree (9 males and 10 females). They are distributed at the different departments as the following:

- **Bachelor's students**

Mathematics	Physics	Chemistry	Biology	Biotechnology	Total No.
113	89	146	55	64	467

- **Master's students**

Physics	Chemistry	Biology	Total No.
5	8	6	19

By the academic year 2018/2019, the total number of Bachelor's students reached to 1998 (637 males and 1361 females), and the number of Master's students approached to 71 (29 males and 42 females). They are distributed at the different departments as the following:

- **Bachelor's students**

Mathematics	Physics	Chemistry	Biology	Biotechnology	Total No.
483	286	666	244	319	1998

- **Master's students**

Physics	Chemistry	Biology	Total No.
28	27	16	71

The faculty members are 114 distributed as the following:

Rank / Dept.	Professor	Associate Professor	Assistant Professor	Lecturer	Tutor	Assistant Tutor	Total
Mathematics	4	13	5	1	4	1	28
Physics	6	9	5	1	–	3	24
Chemistry	8	7	6	3	1	3	28
Biology and Biotechnology	2	11	1	1	3	4	22
Basic Sciences	-	-	-	-	3	9	12
Total	20	40	17	6	11	20	114

The Faculty offers courses leading to B.Sc. degree in mathematics, physics, chemistry, biology and biotechnology.

III. Faculty vision and mission
Vision
The Faculty of Science aims to be the best developed, advanced, and the most innovative in its academic and scientific research programs that conforms to the best international

standards. It also aims to create distinguished and capable graduates to fulfill the needs of the local society currently and in the upcoming future.

Mission

The Faculty of Science aims to develop superior academic undergraduate and graduate programs that are responsive to the needs of evolving workplace and to the economic and social innovation. It also aims to develop academic and research collaborations with industry and community that stimulate and enhance the sustainable social and economic progress.

Our mission will be accomplished via the followings:
1. Prepare specialists and well- qualified human cards in diverse disciplinary stream branches of learning, who could preserve the scientific and cultural heritage by advancing, enriching and developing knowledge, while endeavoring towards ensuring its visibility, publication and progress at both the national and human levels;
2. Transfer knowledge to future generation through education and training;
3. Participate in community service, and work towards the country's economic and cultural development;
4. Strengthen scientific and cultural relations between the Faculty of Science at
Hashemite University and other institutions within the realm of its objectives,
mission, and goals at the local, Arab, Islamic, and international levels.

The philosophy of Faculty of Science envisions the development of higher education through the followings:
1. Ensure continuous development and evaluation of teaching programmers, curricula and educational methods to keep pace with scientific developments;
2. Work towards building the students' talents and provide an atmosphere that encourages their creativity, and develops their potential abilities to analyze, infer and explore the challenges through scientific and research intellectual growth, reasoning and foresight;
3. Focus on developing the students' total personality providing all facilities that develop their creative abilities, through providing continuous learning, guidance, moral, and care, and by encouraging them to participate in campus activities as sports, social and cultural events that are characterized as the complementary to university life;
4. Ensure the availability of all facilities, and a suitable environment that encourages the pursuit of scientific research and scholarly studies, while focusing on prime issues of priority significance relevant to Jordanian community in an effort to find long lasting and suitable solutions;
5. Serve the community by providing teaching and consultative programmers, in addition to research, seminars and public lectures, in effort to make positive contributions to public;
6. Develop an attitude of openness to the community and utilizing and adopting various mechanisms and facilities geared to meet institutional goals;
7. Ensure continuous development of the Faculty staff through intense process of education, seminars, training, workshops, symposia and scholarships;
8. Strengthen cultural and scientific relationships with distinguished universities and scientific institutes;
9. The Faculty provides laboratories with technological tools and modern methods that would facilitate the teaching process;
10. The Faculty concentrates on practical studies and field works in addition to organizing workshops and seminars.

The faculty has modern teaching and research facilities, including the Electron Microscopy Unit, Herbarium, Green House, 30 teaching and 40 research laboratories. In addition, the

faculty ensures an enriching research environment with several sponsored and general facility projects.

Students who wish to enroll in the faculty should hold the Jordanian General Secondary School Certificate (GSSC) or any equivalent certificate with a minimum average of (65%).

IV. Graduation requirements

The Bachelor of Science degree in all majors of the Faculty of Science requires the completion of a minimum of 132 hours of course work. A detailed distribution of the minimum credit hours required is as follows:

Description	Number of credit hours	
l. University Requirements	27	
a) Compulsory Courses		12
b) Elective Courses		15
ll. Faculty Requirements	21	
a) Compulsory Courses		21
b) Elective Courses		-
lll. Department Requirements	81	
a) Compulsory Courses		63
b) Elective Courses		18
lV. Free Elective Courses	3	
Total	**132**	

V- Faculty requirements

Twenty-one (21) credit hours of core coursework are required to fulfill the faculty requirements:

Course Number	Course Title	Weekly Contact Hours		Credit Hours	Prerequisites
		Lecture	Practical		
110108101	Calculus (1)	3	-	3	-
110101102	Calculus (2)	3	-	3	110108101
1701081136	General Physics (1)	3	-	3	-
110102102	General Physics (2)	3	-	3	1701081136
1701081138	General Chemistry (1)	3	-	3	-
110108105	General Biology (1)	3	-	3	-
110108112	Computer programing	3	-	3	110108099

VI. Faculty departments

The faculty of Science includes the following departments: Department of Mathematics, Department of Physics, Department of Chemistry, Department of Biology and Biotechnology and Department of Basic Sciences.

VI.I. Department of Mathematics
VI.I.I. Introduction
Teaching in the Department of Mathematics started at the beginning of the academic year 1995/1996. The department offers a flexible and challenging undergraduate program leading to a Bachelor degree in Mathematics. The curriculum of the department includes traditional core mathematics courses as well as special projects that provide the opportunity for the student to explore areas of individual interest.

The department provides the students of the Faculty of Science and the students of other faculties with the applied mathematical knowledge they need in their specializations. The department helps the students to connect this knowledge with suitable information-technology (IT) applications in their fields. The department's goal is to provide the local, regional, and international markets with well-qualified graduates either for employment or for postgraduate programs.

In the current year 2018/2019, the department has 28 faculty members. The number of Bachelor's students in the department is 483. The minimum requirements for acquiring a Bachelor degree in Mathematics are 132 credit hours completed successfully in accordance with the regulations of the University.

VI.I.II. Department requirements
Eighty-one (81) credit hours coursework are required to fulfill the department requirements as follows:

VI.I.II.ı. Compulsory courses
Sixty- three (63) credit hours of coursework are required to fulfill the department requirements:

Course No.	Course title	Credit hours	Prerequisites
110101201	Calculus (3)	3	110101102
110101203	Ordinary Differential Equations (1)	3	110101102
110101205	Mathematical Programming Packages	3	110108112
110101211	Real Analysis (1)	3	110101251
110101231	Statistical Methods (1)	3	-
110101241	Linear Algebra (1)	3	-
110101251	Foundation of Mathematics	3	-
110101261	Euclidian Geometry	3	-
110101302	Ordinary Differential Equations (2)	3	110101203
110101304	Partial Differential Equations (1)	3	110101203
110101311	Real Analysis (2)	3	110101211
110101321	Probability Theory	3	110101201
110101341	Abstract Algebra (1)	3	110101251
110101343	Number Theory	3	110101251
110101344	Graph Theory	3	110101241 & 110101251

Course No.	Course title	Credit hours	Prerequisites
110101401	Advanced Calculus	3	110101201
110101402	Numerical Analysis (1)	3	110101205 & 110101241
110101413	Complex Analysis	3	110101211
110101433	Mathematical Statistics	3	110101321
110101441	Abstract Algebra (2)	3	110101341
110101461	Topology (1)	3	110101211

VI.I.II.ɪɪ. Elective courses

A minimum of eighteen (18) credit hours of coursework are required and chosen from the following courses:

Course No.	Course title	Credit hours	Prerequisites
110101303	Special Functions	3	110101203
110101305	Linear Programming	3	110101205 &110101241
110101331	Statistical Methods (2)	3	110101231
110101333	Sampling Methods	3	110101331
110101334	Design of Experiments	3	110101331
110101335	Applied Regression Analysis	3	110101331
110101342	Linear Algebra (2)	3	110101241
110101351	Fuzzy Sets	3	110101251
110101361	Non- Euclidian Geometry	3	110101251 & 110101261
110101391	History of Mathematics	3	110101251
110101405	Integral Equations	3	110101203
110101407	Numerical Analysis (2)	3	110101402
110101411	Real Analysis (3)	3	110101311
110101412	Functional Analysis	3	110101311 & 110101461
110101443	Combinatorics	3	110101241 & 110101251
110101444	Matrix Theory	3	110101342
110101462	Topology (2)	3	110101461
110101495	Special Topics	3	Level 90 credit hours at least

VI.I.II.ɪɪɪ. Free elective courses

Students can choose any (3) credit hours course from the courses offered by University's faculties.

VI.I.II.ɪᴠ. Courses offered by the department

The following table represents the whole courses offered by the Department of Mathematics:

Course No.	Course title	Credit hours	Prerequisites
110108101	Calculus (1)*	3	- Given by the department of basic sciences and taught

			by mathematics faculty members
110108102	Principles of Mathematics*	3	- Given by the department of basic sciences and taught by mathematics faculty members
110108103	Principles of Statistics*	3	- Given by the department of basic sciences and taught by mathematics faculty members
110101099	Introduction to Calculus	3	-
110101102	Calculus (2)	3	110108101
110101152	Discreet Mathematics	3	-
110101201	Calculus (3)	3	110101102
110101203	Ordinary Differential Equations (1)	3	110101102
110101205	Mathematical Programming Packages	3	110108112
110101211	Real Analysis (1)	3	110101251
110101231	Statistical Methods (1)	3	-
110101241	Linear Algebra (1)	3	-
110101251	Foundation of Mathematics	3	-
110101261	Euclidian Geometry	3	-
110101302	Ordinary Differential Equations (2)	3	110101203
110101303	Special Functions	3	110101203
110101304	Partial Differential Equations (1)	3	110101203
110101305	Linear Programming	3	110101205 & 110101241
110101311	Real Analysis (2)	3	110101211
110101321	Probability Theory	3	110101201
110101331	Statistical Methods (2)	3	110101231
110101333	Sampling Methods	3	110101331
110101334	Design of Experiments	3	110101331
110101335	Applied Regression Analysis	3	110101331
110101341	Abstract Algebra (1)	3	110101251
110101342	Linear Algebra (2)	3	110101241
110101343	Number Theory	3	110101251
110101344	Graph Theory	3	110101241 & 110101251
110101351	Fuzzy Sets	3	110101251
110101361	Non- Euclidian Geometry	3	110101251 & 110101261
110101391	History of Mathematics	3	110101251
110101401	Advanced Calculus	3	110101201
110101402	Numerical Analysis (1)	3	110101205 & 110101241
110101405	Integral Equations	3	110101203
110101407	Numerical Analysis (2)	3	110101402

110101408	Numerical methods	3	111001110 & 110101241
110101411	Real Analysis (3)	3	110101311
110101412	Functional Analysis	3	110101311 & 110101461
110101413	Complex Analysis	3	110101211
110101433	Mathematical Statistics	3	110101321
110101441	Abstract Algebra (2)	3	110101341
110101443	Combinatorics	3	110101241 & 110101251
110101444	Matrix Theory	3	110101342
110101461	Topology (1)	3	110101211
110101462	Topology (2)	3	110101461
110101495	Special Topics	3	Level 90 credit hours at least

* See Department of Basic Sciences for course description

VI.I.III. Course descriptions

110101099 Introduction to Calculus: 3 CH, (no prerequisite)

This course introduces the students to concepts of equations, inequalities and Functions, limits and continuity, derivatives and integrals and their applications.

110101102 Calculus (2): 3 CH, Prerequisites: 110108101

This course focuses on the inverse of hyperbolic functions and their derivatives and integrals, methods of integration, improper integrals, power series, polar coordinates and polar functions, sequences and infinite series.

110101152 Discrete Mathematics: 3 CH, (no prerequisite)

This course introduces students to the concepts of logic, proof, sets, functions, sequences, series, matrices, growth functions, number theory, mathematical induction, principle of counting, relations, graphs, isomorphic graphs and trees.

110101201 Calculus (3): 3 CH, Prerequisites: 110101102

This course introduces students to concepts of vectors and analytic geometry in space, several variable functions and their limits and partial differentiation and their applications. The course views multiple integrals: double and triple, line integral, surface integral, Green's theorem and Gauss's and Stokes' Theorems.

110101203 Ordinary Differential Equations (1): 3 CH, Prerequisites:110101102

This course sheds light on the solutions of differential equations (first order, second and higher orders) with applications to mechanics and physics. The course discusses series solution of second order linear ordinary differential equations, Laplace transforms and their applications in solving initial value problems.

110101205 Mathematical Programming Packages : 3 CH, Prerequisites:110108112

This course is a deep overview of one of the mathematical programming packages: Matlab, Maple, Mathematica etc. with applications on calculus, linear algebra, differential equations and statistics.

110101211   Real Analysis (1): 3 CH, Prerequisites: 110101251

This course acquaints students with the algebraic, order and completeness properties of real numbers, nested interval properties, Bolzano-Weistrass theorem for sets, Archimedean property, and density theorem of real numbers. It also introduces students to bounded and monotonic sequences, subsequences, Cauchy sequences, sequences of partial sums, limits of functions and sequences by the neighborhood method, continuity, properties of continuous functions as well as uniform continuity, differentiation, mean value theorem, Taylor's theorem and L′ Hospital rule.

110101231   Statistical Methods (1): 3 CH, (no prerequisite)

This course familiarizes students with Minitab package and its uses in the following subjects: descriptive statistics, probability basics, random variables, special discrete random variables and normal distribution. The course includes a discussion of inference about one mean, one proportion, difference between two means, difference between two proportions, ratio of two variances, large and small samples and paired and independent samples.

110101241   Linear Algebra (1): 3 CH, (no prerequisite)

This course handles systems of linear equations, matrices and their operations, homogenous and non-homogenous systems, Gauss elimination method, singular matrices, inverse of matrices, determinants, Crammer's rule, and vector spaces. The course views bases, linear independence, Gramm-Shmidt process, linear transforms, kernel and range of linear transformations, eigenvalues, eigenvectors and diagonalization.

110101251   Foundation of Mathematics: 3 CH, (no prerequisite)

This course familiarizes students with logic, methods of mathematical proof, set theory, relations, functions as well as countable and uncountable sets.

110101261   Euclidian Geometry: 3 CH, (no prerequisite).

This course is an introduction to Euclidean axioms, axioms of continuity, distance, angles and their measures, axioms of correspondence, parallelism and similarity, area, circle, lines and planes in space and solids.

110101302   Ordinary Differential Equations (2): 3 CH, Prerequisites: 110101203

This course tackles linear ordinary differential equations, theorems of existence and uniqueness of solution, orthogonal functions with examples, Sturm-Liouville's theorem, Green's functions, linear systems with constant coefficients, non-linear equations and stability.

110101303   Special Functions: 3 CH, Prerequisites: 110101203

This course discusses Gamma and Beta functions, power series solutions of differential equations, Legendre functions, Bessel function, Chebyshev, Laguerre and Hermite polynomials with applications.

110101304   Partial Differential Equations (1): 3 CH, Prerequisites: 110101203

This course expounds the basics of second order partial differential equations, Fourier series and Fourier integral, wave equation, heat flow equation in one dimension and potential equation on rectangles and disks.

110101305   Linear Programming: 3 CH, Prerequisites: 110101205 & 110101241

This course introduces foundation of linear programming, graphical solutions, simplex method, advanced methods related to simplex method, duality, sensitivity, integer programming and applications.

110101311   Real Analysis (2): 3 CH, Prerequisites: 110101211

This course introduces students to the concepts of Riemann Integral, definitions and properties, Darboux's Theorem, improper integral, definite integrals, integral approximation and sequences of functions. Students will be able to recognize point-wise convergence, uniform convergence, interchange limits, exponential, logarithmic, and trigonometric functions, convergence of infinite series, convergence tests and series of functions.

110101321   Probability Theory: 3 CH, Prerequisites: 110101201

This course handles the distribution of random variables, conditional probability and stochastic independence. Also, it overviews some special distributions like distribution of functions of random variables, distributions of mean and variance of sample of normal distribution, convergence in probability and limiting distributions.

110101331   Statistical Methods (2): 3 CH, Prerequisites: 110101231

This course aims at introducing the statistical packages SAS, SPSS and using them in the analysis of data in the following subjects: simple linear regression and correlation coefficient, multiple correlations, Chi-square test for consistency, independence, and homogeneity. It also handles one and two dimensional analysis of variance with and without reactions, the one and two dimensional factor correction, non-parametric statistics: Wilcoxon test, sign test, Sperman correlation coefficient and Kruskal-Wallis test.

110101333   Sampling Methods: 3 CH, Prerequisites: 110101331

This course explains how to design a questionnaire and how to perform systematic sampling, simple random sampling, stratified sampling, cluster sampling, multistage sampling, ratio estimates and regression estimates. In addition, it explains the use of Minitab to choose samples from different models.

110101334   Design of Experiments: 3 CH, Prerequisites: 110101331

This course helps students to use Minitab and SPSS packages in the following subjects: completely randomized design, randomized block designs, Latin-square design, designs using covariants, multiple comparison, hierarchical (nested) classification models, designing factorial experiments, confounding techniques in 2^n and 3^n designs and optimum designs.

110101335   Applied Regression Analysis: 3 CH, Prerequisites: 110101331

This course covers the principles of regression analysis. It covers specifically, simple linear regression, (least square method, testing and estimation), residuals analysis, model checking, matrix formulation, multiple regression, polynomial regression, selection of independent variables, model building and indicator variables. The statistical software SPSS or Minitab are used in this course.

110101341   Abstract Algebra (1): 3 CH, Prerequisites: 110101251

This course is an introduction to groups, subgroups, cyclic groups, isomorphisms, direct product, cosets and Lagrange's theorem, normal subgroups, quotient groups, first isomorphism theorem, rings, subrings, integral domains and quotient rings.

110101342   Linear Algebra (2): 3 CH, Prerequisites: 110101241

This course highlights finite dimensional vector spaces, linear transformations and matrices, direct sum, dual spaces, Jordan canonical form, inner product and Cayley-Hamilton theorem.

110101343   Number Theory: 3 CH, Prerequisites: 110101251

This course elaborates on division algorithm, divisibility, greatest common divisor, least common multiple, Diophantine equations and prime numbers and their distributions. The course handles the fundamental theorem of arithmetics, linear congruence equations, Chinese remainder theorem, divisibility tests, Fermat's theorem, Euler's theorem and arithmetic functions.

110101344   Graph Theory: 3 CH, Prerequisites: 110101241 & 110101251

This course introduces the basics of Graphs, Paths and Cycles, Distances and Intervals, Binary Operations on Graphs, Blocks, Trees, Planer Graphs, Chromatic Number, Four Colors Conjecture and Directed Graphs.

110101351   Fuzzy sets: 3 CH, Prerequisites: 110101251

This course introduces the definitions of fuzzy sets, operations on fuzzy sets, composition and relations fuzzy and Graph and logic fuzzy.

110101361   Non Euclidian Geometry: 3CH, Prerequisites: 110101251 &110101261

This course introduces the Foundation of Euclidean geometry, the fifth postulate, hyperbolic plane geometry, elliptic plane geometry and the consistency of the non-Euclidean geometries.

110101391   History of Mathematics : 3 CH, Prerequisites: 110101251

This course introduces the history of ancient Mathematics: early number systems and symbols, mathematics in early civilizations, beginnings of Greek mathematics, Euclid, Eratosthenes, Archimedes, and Diophantus. In addition, it elucidates the mathematics of Islam, commentators, Fibonacci, Renaissance, Cardan, cubic and quartic equations. Furthermore, the course describes the beginning of calculus, Descartes, Newton, Leibniz focusing on Mersenne, Fermat, Pascal and Euler.

110101401   Advanced Calculus: 3 CH, Prerequisites: 110101201

This course is an overview of functions of several variables; vector valued functions, differentiation and differential operators, integration, Green's theorem, Gauss's theorem, Stockes' theorem, implicit function theorem and inverse functions, extreme of functions, Liebentz's rule and calculus of variation.

110101402   Numerical Analysis (1): 3 CH, Prerequisites: 110101205 & 110101241

This course enables students to compute errors, their reasons and solve non-linear equations in one variables. Students will learn approximation of functions by interpolation, numerical differentiation and integration, direct methods for solving non-linear equations and some numerical solutions of ordinary differential equations.

110101405   Integral Equations: 3 CH, Prerequisites:110101203

This course introduces types of integral equations, linear integral equations with separable kernels, approximation methods for solving integral equations in solving IVP and BVP and solving integral equations by Laplace and Fourier transforms.

1100101407   Numerical Analysis (2): 3 CH, Prerequisites: 110101402

This course tackles the iterative techniques for solving linear differential systems, numerical solutions for ordinary differential equations, one-step

methods, multi-step methods, solutions of boundary value problems and some numerical solutions for partial differential equations.

110101408   Numerical Methods: 3 CH, Prerequisites: 110101241 & 111001110

This course enables students to compute errors, their reasons and solve non-linear equations in one variables. Students will learn approximation of functions by interpolation, numerical differentiation and integration, direct methods for solving non-linear equations and some numerical solutions of ordinary differential equations.

110101411   Real Analysis (3): 3 CH, Prerequisites: 110101311

This course introduces students to the concepts of Riemann-Stieltjes integral, functions of bounded variations, total variation, Riemann-Stieltjes sum, integration by continuous functions, the Euclidean space of n-dimension, the complementary property of the space $\mathbb{R}^n$, the continuity on $\mathbb{R}^n$, the differentiability on $\mathbb{R}^n$, the partial derivatives and the directional derivatives, the chain rule, the mixed partial derivatives and the Implicit Function Theorem.

110101412   Functional Analysis: 3 CH, Prerequisites: 110101311 & 110101461

This course introduces the meaning of linear spaces and gives examples of normed linear spaces such as $\mathbb{R}^n$, ℓ, C_0, $C[a,b]$, spaces, Hölder-Minkowi's inequalities, convergence and Cauchy sequences completeness. In addition, it gives examples of complete and incomplete spaces and Hilbert and Banach spaces.

110101413   Complex Analysis: 3 CH, Prerequisites: 110101211

This course elaborates on complex numbers, geometric and polar representation of complex numbers, exponentials, and roots, regions in the complex plane, analytic functions, continuity, elementary functions, logarithmic functions and their branches. Students will be exposed to integrals: contour integrals, integrals on closed regions, Cauchy theorem, derivatives of analytic functions, Morera's and Liouville's theorems, convergence of sequences and series, Taylor's and Laurent's series, uniform convergence, residues and poles, residue theorem and improper real integrals.

110101433   Mathematical Statistics: 3 CH, Prerequisites: 110101321

This course introduces students to the concepts of point estimation, sufficient and complete statistics and the family of exponential distributions. It also deals with Cramer-Rao's inequality, confidence intervals, point and interval estimation using Baye's method, hypothesis testing, Neyman-Pearson Iemma, sequential test, Chi-square test and non-parametric methods.

110101441   Abstract Algebra (2): 3 CH, Prerequisites: 110101341

This course introduces the meaning of Ring-homomorphism, Polynomial rings, unique factorization domains, quotient fields, principles of ideal domains, algebraic extensions of fields and introduction to Galios Theory.

110101443   Combinatorics: 3 CH, Prerequisites: 110101241 & 110101251

This course introduces the basics of counting, permutation and combinations, recurrence relations, generating function, inclusion and exclusion, introduction to theory of combinatorial graphs, trees and searching.

110101444   Matrix Theory: 3 CH, Prerequisites: 110101342

This course introduces students to the basics of Kronecker product of matrices, functions of matrices, equations of matrices, differential equations of matrices, eigenvalues and eigenvectors, the characteristic equation and the minimal polynomial of matrices, the Cayly-Hamilton Theorem, the canonical forms, the Gershgorin disks, the diagonalizable matrices, the Hermitian and unitary matrices, Schur's Theorem, the spectrum of normal matrices, the positive matrices, the quadratic forms, the singular value decomposition and the polar decomposition, generalized Moore-Penrose inverses, matrix norms and the QR decomposition.

110101461   Topology (1): 3 CH, Prerequisites: 110101211

This course views topological spaces, open sets, closed sets, closure, interior, and boundary of sets, accumulation point, subspaces and finite product of topological spaces. Students will discuss continuous functions, open and closed functions, homeomorphism, separation axioms, metric spaces, in addition to topologies introduced by metrics.

110101462   Topology (2): 3 CH, Prerequisites: 110101461

This course introduces neighborhood systems, connectedness, compactness and introduction to homotopy groups.

110101495   Special Topics: 3 CH, Prerequisites: Level 90 credit hours at least

This course studies a new topic in mathematics that is prepared by a faculty member and subjected to the department approval.

VI.II. Department of Physics
VI.II.I. Introduction

The Department of Physics at the Hashemite University was one of the first to be established among the university's departments. The principal aim of the Department of Physics is to offer academic programs and high quality research, and to raise students' educational standards to qualify them to fill academic post at universities, in the industry and in the governmental sector.

Courses offered by the Department of Physics are prepared to offer the best opportunities for future scientists to pursue the ever-changing scientific vistas and to give them the best training to compete in the highly competitive job market in our region and the world. The

completion of the bachelor's program and the conferring of the degree require passing 132 credit hours. At present, the department has staff of (20) faculty members, (4) teaching assistant, and (4) technicians. The department has seven teaching labs in addition to four research labs.

VI.II.II. Department requirements

Eighty-one (81) credit hours of coursework are required to fulfill the department requirements as follows:

VI.II.II.ɪ. Compulsory courses

Sixty–three (63) credit hours of coursework are required to fulfill the department requirements:

Course Number	Course Title	Weekly Hours		Credit Hours	Prerequisites
		Lecture	Laboratory		
110101203	Ordinary Differential Equations (1)	3	0	3	110101102
110102103	General Physics Laboratory (1)	0	3	1	1701081136 or concurrent
110103103	General Chemistry Laboratory (1)	0	3	1	1701081138 or concurrent
1801041103	Practical General Biology (1)	0	3	1	110108105 or concurrent
110102104	General Physics Laboratory (2)	0	3	1	110102102 or concurrent and 110102103
110102141	Thermal and Material Physics	3	0	3	110102102
110102203	General Physics (3)	3	0	3	110102102
110102211	General Physics Laboratory (3)	0	3	1	110102203 or concurrent
110102232	Electronics	3	0	3	110102102
110102261	Modern Physics (1)	3	0	3	110102102 and 110101102
110102262	Modern Physics (2)	3	0	3	110102261
110102281	Mathematical Physics (1)	3	0	3	110102102 and 110101102
110102282	Mathematical Physics (2)	3	0	3	110102281 and 110101203
110102283	Computer Applications in Physics Laboratory	0	3	1	110102203
110102311	Electronics Laboratory	0	3	1	110102232
110102312	Advanced Physics Laboratory (1)	0	6	2	110102211 and 110102261
110102321	Physical Optics	3	0	3	110102203 and 110102281
110102331	Electricity and Magnetism (1)	3	0	3	110102282
110102332	Electricity and	3	0	3	110102331

Course Number	Course Title	Lecture	Laboratory	Credit Hours	Prerequisites
	Magnetism (2)				
110102341	Thermodynamics	3	0	3	110102141 and 110102281
110102351	Classical Mechanics	3	0	3	110102281 and 110101203
110102362	Quantum Mechanics (1)	3	0	3	110102261 and 110102282
110102364	Quantum Mechanics (2)	3	0	3	110102362 and 110102262
110102411	Advanced Physics Laboratory (2)	0	6	2	110102364
110102442	Statistical Mechanics	3	0	3	110102341 and 110102364
110102471	Solid State Physics	3	0	3	110102364
110102491	Seminar	1	0	1	Student has finished 90 credit hours

VI.II.II.ɪɪ. Elective courses

A minimum of eighteen (18) credit hours of coursework are required and selected from the following list:

Course Number	Course Title	Weekly Hours		Credit Hours	Prerequisites
		Lecture	Laboratory		
110102322	Waves and Vibrations	3	0	3	110102281
110102329	Astrophysics	3	0	3	110102261
110102361	Special theory of Relativity	3	0	3	110102261
110102363	Medical Physics	3	0	3	110102262
110102383	Computational Physics	2	3	3	110102282
110102433	Plasma Physics	3	0	3	110102332
110102461	Atomic and Molecular Physics	3	0	3	110102364
110102463	Nuclear Physics	3	0	3	110102364
110102464	Laser Physics	3	0	3	110102364
110102465	Radiation Physics	3	0	3	110102262
110102467	Biophysics	3	0	3	110102262
110102472	Physics of Semiconductors	3	0	3	110102471
110102495	Special Topics	3	0	3	Student has finished 90 credit hours
110103102	General Chemistry (2)	3	0	3	1701081138

VI.II.II.ɪɪɪ. Free elective courses

Physics Students can choose any (3) credit hours course from courses offered by the University's faculties including the Faculty of Science, except the following two courses.
1. General physics (110102107)
2. General physics laboratory (110102108)

VI.II.II.ɪv. Courses offered by the department

The following table represents the whole courses offered by the Department of Physics:

Course Number	Course Title	Weekly Hours		Credit Hours	Prerequisites
		Lecturer	Laboratory		
110102099	Principles of General Physics	3	0	3	-
1701081136	General Physics* (1)	3	0	3	Given by the department of basic sciences and taught by physics faculty members
110102102	General Physics (2)	3	0	3	1701081136
110102103	General Physics Laboratory (1)	0	3	1	1701081136 or concurrent
110102104	General Physics Laboratory (2)	0	3	1	110102102 or concurrent and 110102103
110102107	General Physics	3	0	3	-
110102108	General Physics Laboratory	0	3	1	110102107 or concurrent
110102109	General Physics for Medical Students	3	0	3	-
110102141	Thermal and Material Physics	3	0	3	110102102
110102203	General Physics (3)	3	0	3	110102102
110102211	General Physics Laboratory (3)	0	3	1	110102203 or concurrent
110102232	Electronics	3	0	3	110102102
110102261	Modern Physics (1)	3	0	3	110102102 and 110101102
110102262	Modern Physics (2)	3	0	3	110102261
110102281	Mathematical Physics (1)	3	0	3	110102102 and 110101102
110102282	Mathematical Physics (2)	3	0	3	110102281 and 110101203
110102283	Computer Applications in Physics Laboratory	0	3	1	110102203
110102311	Electronics Laboratory	0	3	1	110102232
110102312	Advanced Physics Laboratory (1)	0	6	2	110102211 and 110102261
110102321	Physical Optics	3	0	3	110102203 and 110102281
110102322	Waves and Vibrations	3	0	3	110102281
110102329	Astrophysics	3	0	3	110102261

110102331	Electricity and Magnetism (1)	3	0	3	110102282
110102332	Electricity and Magnetism (2)	3	0	3	110102331
110102341	Thermodynamics	3	0	3	110102281 and 110102141
110102351	Classical Mechanics	3	0	3	110102281 and 110101203
110102361	Special theory of Relativity	3	0	3	110102261
110102362	Quantum Mechanics (1)	3	0	3	110102261 and 110102282
110102363	Medical Physics	3	0	3	110102262
110102364	Quantum Mechanics (2)	3	0	3	110102362 and 110102262
110102383	Computational Physics	2	3	3	110102282
110102411	Advanced Physics Laboratory (2)	0	6	2	110102364
110102433	Plasma Physics	3	0	3	110102332
110102442	Statistical Mechanics	3	0	3	110102341 and 110102364
110102461	Atomic and Molecular Physics	3	0	3	110102364
110102463	Nuclear Physics	3	0	3	110102364
110102464	Laser Physics	3	0	3	110102364
110102465	Radiation Physics	3	0	3	110102262
110102467	Biophysics	3	0	3	110102262
110102471	Solid State Physics	3	0	3	110102364
110102472	Physics of Semiconductors	3	0	3	110102471 or concurrently
110102491	Seminar	1	0	1	Student has finished 90 credit hours
110102495	Special Topics	3	0	3	Student has finished 90 credit hours

* See Department of Basic Sciences for course description

VI.II.III. Course descriptions

110102099   Principles of General Physics; 3 CH (3+0)

This course introduces the students to general principles in physics such as units and measurements, density and atomic mass, conversion of units, dimensional analysis. In addition, it explains the concepts of mechanics like Vectors, one-dimensional motion, Newton's laws and applications of Newton's laws. The course also explains the basics of electricity by discussing Coulomb's law, the electric field for point charges, electric potential for point charges, current and resistance, resistors in series and in parallel, Ohm's law, electric circuits for direct current and capacitors and

their connection in series and in parallel. Finally, the course covers several topics in magnetism such as magnetic field, motion of a charge in a magnetic field and magnetic force on a conductor carrying current.

110102102   General Physics (2); 3 CH (3+0) Prerequisites: 1701081136

This course explains the principles of charge and matter, electric field, Gauss's Law and its applications, electric potential, capacitance and dielectrics, current and resistance, electromotive force and circuits, magnetic force on a charge and on a wire carrying current, sources of magnetic field, Biot-Savart law, Ampere's law, electromagnetic induction and Faraday's law.

110102103   General Physics Laboratory (1); 1 CH (0+3) Prerequisites: 1701081136 or concurrently

Students perform some experiments of 3 hrs/week that related to the course content of 1701081136. These experiments include: Collection and analysis of data, measurements and errors, vectors, kinematics of rectilinear motion, force and motion, collision in two dimensions, rotational motion, simple pendulum, measurement of acceleration of gravity and measurement of coefficient of friction and specific heat of metals.

110102104   General Physics Laboratory (2); 1 CH (0+3) Prerequisites: 110102102 or concurrently and 110102103

Students perform some experiments of 3 hrs/week that are related to the course content of 110102102. These experiments include: electric field mapping, specific charge of copper ions, Wheatstone bridge, power transfer, potentiometer, capacitors in series and parallel, analysis of RC circuits for dc current, Kirchhoff's rules, Ohm's law, magnetic field of a current, electromagnetic induction, mechanical equivalent of heat and converging and diverging lenses.

110102107   General Physics; 3 CH (3+0)

This course introduces the students to the basics of mechanics, which include kinematics and dynamics of motion of particles, circular motion, work and energy. In addition, it elucidates the principles of electricity such as electric force, electric field, electric potential, current and resistance and capacitors. Furthermore, the course covers the basics of magnetism like magnetic force and magnetic field as well as the basics of thermal properties of matter such as coefficient of linear expansion, specific heat and heat capacity, heat transfer, diffusion and first law of thermodynamics. Finally, the course explains the elements of fluid mechanics which include: density, pressure, gas laws, Archimedes principle, continuity equation, Bernoulli equation, viscosity, description of wave motion, velocity of waves, properties of (α, β, γ) rays, x-rays, radioactive decay and half-life period.

110102108   **General Physics Laboratory; 1 CH (0+3) Prerequisites: 110102107 or concurrently**

Students perform some experiments of 3 hrs/week that related to the course content of 110102107. These experiments include: Collection and analysis of data, measurements and errors, vectors, kinematics of rectilinear motion, force and motion, simple pendulum, Charles and Boyles laws of gases, specific heat for metals, viscosity, surface tension, electric field mapping, specific charge of copper ions, power transfer and Ohm's law.

110102109   **General Physics for Medical Students; 3 CH (3+0)**

This course discusses several concepts related to mechanics of motion and levers, light, sound waves and its medical applications, dynamics of fluids and its medical applications, electrostatic force, direct current, current in biological cells, principles of radiation and radiation production.

110102141   **Thermal and Material Physics; 3 CH (3+0) prerequisites: 110102102**

This course introduces students to basic concepts in thermal physics and material physics. Topics covered in this course include temperature, internal energy, heat, entropy, first and second laws of thermodynamics, kinetic theory of gases, energy transfer by conduction, convection, and radiation, atomic structure, electron configurations in atoms, periodic table, bonding in solids, types of primary and secondary interatomic bonds, crystalline solids, crystal structure and unit cell, simple three dimensional crystal structures (SC, BCC, and FCC), Miller indices, x-ray diffraction and Bragg's law.

110102203   **General Physics (3); 3 CH (3+0) Prerequisites: 110102102**

This course introduces students to the basics of general physics, which include fluid mechanics, simple harmonic motion, wave motion, sound waves, interference of sound waves, alternating current, electromagnetic waves, geometrical optics, interference, diffraction and polarization in optics.

110102211   **General Physics Laboratory (3); 1 CH (0+3) Prerequisites: 110102203 or concurrently**

Students perform some experiments of 3 hrs/week. The experiments include: Diffraction grating, single slit diffraction, prism spectrometer, Young's double slit, Newton's rings, polarization of light, inverse square law and the propagation of light, mirrors, concave and convex lenses, thermocouples, temperature coefficient of Resistance and thermostat.

110102232   **Electronics; 3 CH (3+0) Prerequisites: 110102102**

This course introduces the students to the principles of passive and active elements of electric circuits, DC and AC circuits analysis, introduction to semiconductors, p-n junction, rectifying diode models, diode applications,

zener diode and its applications, bipolar junction transistor, transistor biasing circuits and small signal bipolar transistor amplifier.

110102261   Modern Physics (1); 3 CH (3+0) Prerequisites: 110102102 and 110101102

This course introduces students to several fundamentals related to special relativity, structure of matter, atomic structure, models of the atom, Quantum theory of radiation, Planck's radiation law, Compton Effect, wave nature of matter, x-ray diffraction, particle diffraction, De Broglie postulate. In addition, it introduces quantum mechanics by explaining Schrodinger's equation and some of its applications.

110102262   Modern Physics (2); 3 CH (3+0) Prerequisites: 110102261

This course describes the structure of hydrogen atom, many electrons atoms and molecules. It also introduces the concepts of statistical physics, solid state physics and nuclear physics.

110102281   Mathematical Physics (1); 3 CH (3+0) Prerequisites: 110102102 and 110101102

The course explains for the students the concepts of series and complex numbers, which include complex plane, complex algebra, complex series, complex functions and applications in quantum mechanics. The course also elucidates how to perform vector analysis: triple products and application in mechanics (work, torque). In addition, it discusses several subjects like directional derivatives, gradient, line integrals, the divergence theorem, Stoke's theorem, Gauss law in static electricity, determinants and matrices. The course also covers the different types of coordinate transformation, which include linear transformation, orthogonal transformation, eigenvalues and eigenvectors, and diagonalisation of matrices. Finally, the course expands on different topics like Fourier series such as periodic functions, sinusoidal functions and applications on Euler and Lagrange equations.

110102282   Mathematical Physics (2); 3 CH (3+0) Prerequisites: 110102281and 110101203

This course covers several concepts related to special functions like Gamma function, Beta function, Error function, Elliptic integrals. Also, it explaines the series solution of differential equations, Legendre polynomials, associated Legendre polynomials, Bessel functions, Hermite polynomials, Laguerre polynomials, Partial differential equations in Cartesian and spherical and cylindrical coordinates. Furthermore, it expands on functions of a complex variable: Cauchy-Riemann conditions, Laurent series, Residue theorem and evaluating integrals using the residue theorem.

110102283   Computer Application in Physics Laboratory; 1 CH (0+3) Prerequisites: 110102203

This course introduces students to the principles of personal computer application in simulation programs in one and two dimensional motions, Newton's laws of motion, potential and kinetic energies, work and energy, conservation of mechanical energy, momentum and collision, rotational motion, electric field, Gauss's law, electric potential, capacitance, capacitors, current and resistance, magnetic field, Faraday's law, inductors and some simulations in optics and modern physics.

110102311   Electronics Laboratory; 1 CH (0+3) Prerequisites: 110102232

Students perform some experiments of 3 hrs/week that are related to the course content of 110102232. The experiments include measurement techniques using the oscilloscope, analysis of RC for AC circuits, RLC circuit analysis, properties of diodes & transistors, using diodes in rectifiers and filters, Zener diode, Diode circuits, clippers and clamps, transistor response, transistor as amplifier and Compensated and uncompensated operational amplifiers.

110102312   Advanced Physics Laboratory (1); 2 CH (0+6) Prerequisites: 110102261 and 110102211

Students perform some experiments of 6 hrs/week that are related to modern physics, optics, quantum optics and solid state physics. The experiments include: velocity of sound in liquids, electrical conductivity, tangent galvanometer, polarization, Michelson interferometer, measurement of charge of the electron to Boltzmann constant, Hall effect, Roland grating, measurement of dielectric constant for liquids, laser diode, Faraday's effect and Kerr effect.

**110102321   Physical Optics; 3 CH (3+0) Prerequisites: 110102203 and
                110102281**

This course introduces the students to several concepts related to wave equation, Poynting vector, superposition of waves, interference of light, optical interferometry, diffraction of light, Fraunhofer and Fresnel diffraction, coherence and polarization

110102322   Waves and Vibrations; 3 CH (3+0) Prerequisites: 110102281

This course introduces the students to principles of simple harmonic motion with applications to include additions, subtractions and modulations. The course also explains the damped harmonic motion to include the variables of this motion and energy dissipation, the quality factor and forced oscillations to include the concept of impedance, resonance and the resonance power curve. Moreover, it describes coupled oscillations to include mechanical and electrical systems, the coupling strength to introduce the concept of degrees of freedom and coupling in extended systems as a prerequisite to wave motion. Finally, the course put emphasis on transverse waves by studying wave variables, wave equation, impedance and group and phase velocities. The course also covers wave propagation in periodic structures, reflection and transmission of waves, longitudinal waves and waves in more than one dimension.

110102329   Astrophysics; 3 CH (3+0) prerequisites: 110102261

This course describes for students the basics of photosphere, chromospheres and corona, sun spots and magnetic fields on the sun, solar activity, solar wind and solar-terrestrial relationship, main sequence stars, collapsed stars, Pulsars, interstellar medium, galaxies and active galaxies.

110102331   Electricity and Magnetism (1); 3 CH (3+0) Prerequisites: 110102282

This course introduces students to the fundamentals of electrostatics, electrostatic field, divergence and curl of electrostatic fields, electric potential, work and energy in electrostatics, conductors and insulators, special techniques for calculating potentials, Laplace's equation, method of images, multipole expansion, electrostatic fields in matter, polarization and dipole moment density, field of a polarized object, electric displacement, linear dielectrics, magnetostatics, Lorentz force law, Biot-Savart law, divergence and curl of the magnetic field, magnetic, vector potential, magnetostatic field in matter, magnetization, field of a magnetized object and linear and nonlinear media.

110102332   Electricity and Magnetism (2); 3 CH (3+0) Prerequisites: 110102331

This course introduces the students to the basics of propagation of electromagnetic waves; Maxwell's equations; electromagnetic waves; plane electromagnetic waves: propagation, reflection and transmission of waves; Boundary conditions in conductors and insulators; electromagnetic radiation: dipole and quadrupole radiation, wave guides and cavities, retarded potentials and radiation from a point charge and applications: antennas, diffraction theory, waveguides, nonlinear optics and synchrotrons.

110102341   Thermodynamics; 3 CH (3+0) Prerequisites: 110102141 and 110102281

This course introduces students to the concepts of mathematical review, equation of state, zeroth law of thermodynamics, first law in thermodynamic, entropy and the second law of thermodynamics, combination of the first and second laws of thermodynamics, thermodynamic potentials and applications of thermodynamics to simple systems.

110102351   Classical Mechanics; 3 CH (3+0) Prerequisites: 110102281and 110101203

This course introduces students to the fundamentals of Gravitation: universal law of gravitation, gravitational field, gravitational potential and potential energy, inertial mass and gravitational mass; Lagrangian dynamics: principle of least action: Euler's equation, generalized coordinates and generalized momenta, generalized forces, Lagrangian equations of motion and Hamilton's equations of motion; Central forces: reduced mass, energy equation, effective potential, equations of central

motion, planetary motion and Kepler laws; Dynamics of many-particle system: center of mass, linear momentum, angular momentum, energy, elastic collision and inelastic collision; Dynamics of rigid bodies: motion of a point particle in an inertial and accelerated frames, motion of rigid bodies in inertial and accelerated frames, moment of inertia tensor of a rigid body, angular momentum and kinetic energy tensors.

110102361   Special Theory of Relativity; 3 CH (3+0) Prerequisites: 110102261

This course describes the principles of Galilean relativity, Einstein's relativity principle, time dilation, length contraction, Lorentz transformations, spacetime interval and Minkowski diagrams, Doppler effect, twin paradox, light cone, causality, relativistic dynamics (mass and momentum), equivalence of mass and energy, four vectors, energy-momentum four vector, Collisions and relativistic electromagnetism.

110102362   Quantum Mechanics (1); 3 CH (3+0) Prerequisites: 110102261 and 110102282

This course introduces students to basic topics in quantum mechanics and applications. Topics to be covered in this course include: the emergence of quantum physics, wave particle duality, probability, the Schrödinger equation, eigenvalues, eigefunctions, expansion postulate, one-dimensional potentials, the general structure of wave mechanics, operator methods in quantum mechanics and angular momentum

110102363   Medical Physics; 3 CH (3+0) Prerequisites: 110102262

This course introduces students to the basics of forces in the body, physics of the skeleton, energy, work and power in the body, concepts of heat, cold, pressure, physics of capillary system, electricity in the body, physics of x-ray technology and physics of radiation therapy.

110102364   Quantum Mechanics (2); 3 CH (3+0) Prerequisites: 110102362 and 110102262

This course introduces students to advanced topics in quantum mechanics and applications. Topics covered in this course include: angular momentum and commutation relations, raising and lowering operators of angular momentum, the Schrodinger equation in three dimensions, the free particle, central potentials, the hydrogen atom and its energy spectrum, the infinite spherical potential well, matrix representation of angular momentum operator, spin ½ Pauli theory, general rules for addition of angular momenta, time-independent perturbation theory (degenerate and non-degenerate), the stark effect, the real hydrogen atom, relativistic kinetic energy, spin-orbit coupling, the anomalous Zeeman effect and the hyperfine structure

110102383   Computational Physics; 3 CH (2+1) Prerequisites: 110102282

This course explains the basics of programming, basics of numerical analysis, python programming language as the main programming tool,

numerical interpolation, numerical fitting, root finding using numerical techniques, numerical differentiations, numerical integration and numerical solution of first and second order differential equations. The course also illustrates solutions of some physics problems with different methods using numerical techniques.

110102411   Advanced Physics Laboratory (2); 2 CH (0+6) Prerequisites: 110102364

Students perform some advanced experiments of 6 hrs/week that are related to solid state physics, optics and atomic physics. The experiments include: electron diffraction, Rutherford backscattering, Zeeman effect, x-ray diffraction, electron spin resonance, Frank-Hertz experiment, Balmer series, measurement of specific charge of the electron (e/m), Millikan oil-drop experiment, Planck's constant and Gamma spectrometry.

110102433   Plasma Physics; 3 CH (3+0) Prerequisites: 110102332

This course elucidates the principles of Maxwell's equations, propagation of electromagnetic waves in conducting media, plasma fluid model, magneto-hydrodynamics, waves in plasma, instabilities in plasma and kinetic theory in plasma.

110102442   Statistical Mechanics; 3 CH (3+0) Prerequisites: 110102341 and 110102364

This course describes the basic concepts in thermodynamics, the statistical approach and Boltzmann statistics, the canonical ensemble, the grand canonical ensemble, quantum statistics and quantum ensembles, the Fermi gas, The Bose gas and Bose-Einstein condensation

110102461   Atomic and Molecular Physics; 3 CH (3+0) Prerequisites: 110102364

This course describes the fundamentals of application of quantum theory to atomic structure and the interaction of electromagnetic radiation with one-electron atom by describing electric-dipole approximation and transition rules, transition rates, line spectra and lifetimes, static perturbations including fine structure and Stark effect and Zeeman effect. The course also explains the basics of two-electron atoms: two-excitation levels and Auger effect as well as many-electron atoms: central field approximation, L-S and j-j couplings, interaction with radiation and electromagnetic fields including Fermi's golden rule, lifetimes of excited states, transition selection rules and Wigner-Eckart theorem. Furthermore, the course elucidates the principles of simple molecules by describing electronic structure, molecular spectra, vibrations and rotations of diatomic molecules.

110102463   Nuclear Physics; 3 CH (3+0) Prerequisites: 110102364

This course describes the basic nuclear concepts and nuclear forces such as the deuteron, scattering theory, conservation laws, nuclear models,

electromagnetic interactions, weak interactions, strong interactions, radioactive decay, nuclear fission and fusion.

110102464   Laser Physics; 3 CH (3+0) Prerequisites: 110102364

This course describes the principles of ray tracing, optical cavity, Gaussian beam, resonant optical cavity, atomic radiation, laser oscillations & amplification, general characteristics of lasers, laser Excitation and laser types.

110102465   Radiation Physics; 3 CH (3+0) Prerequisites: 110102262

This course illustrates the basics of radioactivity: radioactive transformations; Interaction of radiation with matter: alpha particles, beta particles and gamma rays; Radiation dosimetry: absorbed dose and exposure dose measurement; Radiation detectors: particle detectors, photon detectors and nuclear track detectors and radiation protection: shielding.

110102467   Biophysics; 3 CH (3+0) Prerequisites: 110102262

This course explains the basics of molecular structure, function of biological macromolecules, measurement of fluorescence lifetime, molecular spectroscopes, fluorescence polarization, singlet oxygen, physics of traps, solute-solvent interactions, mechanisms and dynamics of solvent relocation, electrostatic forces, charged ions, molecular modeling, structure and fluorescence of protein and antibody structure and function.

110102471   Solid State Physics; 3 CH (3+0) Prerequisites: 110102364

This course describes the basics of crystal lattice: Bravais lattice; structure of solids: crystal structure; elastic scattering of waves; crystal bonding; phonons; thermal properties of crystalline solids and electron states: free electron model, nearly-free electron model, band theory and Fermi surfaces.

110102472   Physics of Semiconductors; 3 CH (3+0) Prerequisites: 110102471 or concurrently

This course explains the basics of semiconductor crystal structure, crystal impurities and statistical properties of semiconductors. It also describes the transport of charge carriers in semiconductors, diffusion and scattering and semiconductor devices.

110102491   Seminar; 1 CH (1+0) Prerequisites: Student has finished 90 credit hours and departmental approval

This course explains the information research methods and presentation of information. The student chooses, by agreement with the instructor, a subject in one of the branches of physics to write a report and presents a seminar to students.

110102495   Special topics; 3 CH (3+0) Prerequisites: Student has finished 90 credit hours and departmental approval

> This course studies a new topic in physics that is prepared by a faculty member and subjected to department approval.

VI.III. Department of Chemistry
VI.III.I. Introduction

Teaching in Department of Chemistry started in 1995. The Department offers bachelor's and master's degrees in chemistry. The primary mission of the department is to ensure that the students are professionally educated and trained in contemporary chemical sciences. The requirement for the B.Sc. degree in chemistry is minimum of (132) credit hours. Students are normally allowed to do a chemistry project in their fourth year. At present, the department has staff of (28) faculty members and (6) technicians. The department has 4 general chemistry teaching labs, 3 teaching labs for analytical, physical and instrumental chemistry and 3 teaching labs for organic and inorganic chemistry. There are also (7) research labs and (5) instruments labs. The department organized a regular series of public lectures given by guest speakers as well as by members of the faculty in the department. Apart from its own students, the department teaches basic chemistry courses to students from other departments of the Faculty of Science and other faculties in the University.

VI.III.II. Department requirements

Eighty-one (81) credit hours of coursework are required to fulfill the department requirements as follows:

VI.III.II.ɪ. Compulsory courses

Sixty-seven (67) credit hours of coursework are required to fulfill the department requirements:

Course No.	Course Title	Weekly Hours		Credit Hours	Prerequisites
		Lecture	Laboratory		
110101203	Ordinary Differential Equations (1)	3	0	3	110101102
110102261	Modern Physics (1)	3	0	3	110102102
110103102	General Chemistry (2)	3	0	3	1701081138
110103105	General Chemistry Laboratory	1	3	2	110103102 or concurrently
110103211	Fundamentals of Analytical Chemistry	3	0	3	110103102 or 1701081137
110103213	Practical Analytical Chemistry	0	3	1	110103211 or concurrently and 110103105 or 110103108
110103221	Inorganic Chemistry (1)	3	0	3	110103102
110103231	Organic Chemistry (1)	3	0	3	110103102
110103232	Organic Chemistry	3	0	3	110103231

Course No.	Course Title	Lecture	Laboratory	Credit Hours	Prerequisites
	(2)				
110103235	Organic Chemistry Laboratory (1)	1	3	2	110103232 or concurrently and 110103105
110103241	Physical Chemistry (1)	3	0	3	110103102 and 110101102
110103311	Instrumental Analysis (1)	3	0	3	110103211, 110103213, 110103102
110103312	Instrumental Analysis (2)	2	3	3	110103311
110103313	Instrumental Analysis Lab	0	3	1	110103312 or concurrently
110103321	Inorganic Chemistry (2)	3	0	3	110103221
110103325	Inorganic Chemistry laboratory	1	5	3	110103321, 110103105
110103331	Spectroscopy of Organic Compounds	3	0	3	110103232
110103335	Identification of Organic Compounds	2	5	4	110103235
110103341	Physical Chemistry (2)	3	0	3	110103241, 110103221
110103342	Physical Chemistry (3)	2	0	2	110103341, 110101203 or con
110103345	Physical Chemistry Laboratory	1	2x3	3	110103342 or con
110103412	Environmental Analytical Chemistry	3	0	3	110103311
110103421	Inorganic Chemistry (3)	3	0	3	110103321
110103432	Organic Chemistry (3)	3	0	3	110103232
180104103	Practical General Biology (1)	0	3	1	110108105 or con

VI.III.II.ɪɪ. Elective courses

A minimum of fourteen (14) credit hours of coursework are required and selected from the following list:

Course No.	Course Title	Weekly Hours		Credit Hours	Prerequisites
		Lecture	Laboratory		
110102103	General Physics Lab (1)	0	3	1	1701081136 or con
110102104	General Physics Lab (2)	0	3	1	110102102 or con, and 110102103
110103413	Industrial Analysis	2	3	3	110103311
110103422	Organometallic Chemistry	3	0	3	110103321
110103433	Natural Products	3	0	3	110103232

Course Number	Course Title	Lecture	Laboratory	Credit Hours	Prerequisites
	Chemistry				
110103441	Molecular Spectroscopy	3	0	3	110103342
110103444	Photochemistry	3	0	3	110103342
110103445	Electrochemistry & Corrosion	3	0	3	110103341
110103461	Industrial Chemistry	3	0	3	110103232 and 110103321
110103464	Polymer Chemistry	3	0	3	110103232
110103491	Seminar	1	0	1	90 credits hours or more
110103495	Special Topics in Organic and Inorganic Chemistry	3	0	3	90 credits hours or more
110103496	Scientific Research	3	0	3	90 credits hours or more
110103497	Special Topics in Analytical and Physical Chemistry	3	0	3	90 credits hours or more
1801041102	General Biology (2)	3	0	3	110108105
1801041222	Biochemistry (1)	2	0	2	1801041102 and (110103236 or 110103232 or 1701081137)

VI.III.II.ɪɪɪ. Free elective courses

Students can choose any (3) credit hours course from courses offered by the University's faculties.

VI.III.II.ɪᴠ. Courses offered by the department

The following table represents the whole courses offered by the Department of Chemistry:

Course Number	Course Title	Weekly Hours		Credit Hours	Prerequisites
		Lecture	Laboratory		
110103099	Principles of Chemistry	3	0	3	-
1701081137	Basics of General Chemistry*	3	0	3	- Given by the department of basic sciences and taught by chemistry faculty members
1701081138	General Chemistry* (1)	3	0	3	- Given by the department of basic sciences and

					taught by chemistry faculty members
110103102	General Chemistry (2)	3	0	3	1701081138
110103103	General Chemistry Laboratory (1)	0	3	1	1701081138 or concurrently
110103104	General Chemistry Laboratory (2)	0	3	1	110103102 or concurrently and 110103103
110103105	General Chemistry Laboratory	1	3	2	110103102 or concurrently
110103108	Basics of General Chemistry Laboratory	0	3	1	1701081137 or concurrently
110103211	Fundamentals of Analytical Chemistry	3	0	3	110103102 or 1701081137
110103213	Practical Analytical Chemistry	0	3	1	110103211 or concurrently and 110103105 or 110103108
110103221	Inorganic Chemistry (1)	3	0	3	110103102
110103231	Organic Chemistry (1)	3	0	3	110103102
110103232	Organic Chemistry (2)	3	0	3	110103231
110103235	Organic Chemistry Laboratory (1)	1	3	2	110103232 or concurrently and 110103105
110103236	Basics of Organic Chemistry	3	0	3	1701081138 or 1701081137
110103237	Basics of Organic Chemistry for Medicine	3	0	3	-
110103241	Physical Chemistry (1)	3	0	3	110103102 and 110101102
110103311	Instrumental Analysis (1)	3	0	3	110103211, 110103213, 110103102
110103312	Instrumental Analysis (2)	2	3	3	110103311
110103313	Instrumental Analysis Lab	0	3	1	110103312 or concurrently
110103321	Inorganic Chemistry (2)	3	0	3	110103221
110103325	Inorganic Chemistry laboratory	1	5	3	110103321, 110103105
110103331	Spectroscopy of Organic Compounds	3	0	3	110103232
110103335	Identification of	2	5	4	110103235

	Organic Compounds				
110103341	Physical Chemistry (2)	3	0	3	110103241, 110103221
110103342	Physical Chemistry (3)	2	0	2	110103341, 110101203 or con
110103345	Physical Chemistry Laboratory	1	2x3	3	110103342 or con
110103412	Environmental Analytical Chemistry	3	0	3	110103311
110103413	Industrial Analysis	2	3	3	110103311
110103421	Inorganic Chemistry (3)	3	0	3	110103321
110103422	Organometallic Chemistry	3	0	3	110103321
110103432	Organic Chemistry (3)	3	0	3	110103232
110103433	Natural Products Chemistry	3	0	3	110103232
110103441	Molecular Spectroscopy	3	0	3	110103342
110103444	Photochemistry	3	0	3	110103342
110103445	Electrochemistry & Corrosion	3	0	3	110103341
110103461	Industrial Chemistry	3	0	3	110103232 and 110103321
110103464	Polymer Chemistry	3	0	3	110103232
110103491	Seminar	1	0	1	90 credits hours or more
110103495	Special Topics in Organic and Inorganic Chemistry	3	0	3	90 credits hours or more
110103496	Scientific Research	3	0	3	90 credits hours or more
110103497	Special Topics in Analytical and Physical Chemistry	3	0	3	90 credits hours or more

* See Department of Basic Sciences for course description

VI.III.III. Course descriptions

110103099   Principles of Chemistry: 3 CH (3+0) Prerequisite:

> The course is designed for students who did not take chemistry in secondary school. It introduces briefly the following: Scientific vocabulary, terminology conventions (including symbols, formulas, quantities, and units), matter and its properties and energy and energy changes. It also helps students to understand the concepts of mole, molar masses and stoichiometric calculations. The course explains the basics of atomic structure and chemical reactions such as acid–base and redox reactions. Finally, it provides the students with introductory remarks about organic compounds.

110103102   General Chemistry (2): 3 CH (3+0) Prerequisite: 1701081138

This course introduces students to principles of states of matter and intermolecular forces, physical properties of solutions, thermochemistry and chemical thermodynamics, chemical equilibrium in gaseous systems, acid-base equilibria in aqueous solutions, solubility and complex ion equilibria, electrochemistry, chemical kinetics and effect of temperature on reaction rates.

110103103   General Chemistry Laboratory (1): 1 CH (0+3) Prerequisite: 1701081138 or concurrently

This course explains the fundamentals of safety and laboratory rules, chemical observation, Avogadro's number, stoichiometry volumetric analysis, oxidation-reduction and cations and anions tests.

110103104   General Chemistry Laboratory (2): 1 CH (0+3)), Prerequisite: 110103102 or concurrently and 110103103

The course describes experiments in topics such as colligative properties, equilibrium, thermochemistry, thermodynamics, chemical kinetics, solubility and complex ion equilibria, electrochemistry and oxidation-reduction reactions.

110103105   General Chemistry Laboratory: 2 CH. (1+3), Prerequisite: 110103102 or concurrently

This course illustrates safety and laboratory rules, in addition to the following experimental topics: moles stoichiometry, gases, volumetric analysis (titration), cations and anions detection, colligative properties, chemical Kinetics, chemical equilibrium, thermodynamics, electrochemistry and oxidation-reduction reactions.

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110103108   Basics of General Chemistry Laboratory: 1 CH. (0+3), Prerequisite: 1701081137 or concurrently

The course introduces the students to the principles of safety, laboratory rules and laboratory techniques as well as selected experiments to illustrate some important topics such as chemical calculations, colligative properties, thermochemistry, chemical equilibrium and solubility product constant, pH and buffer solutions and electrochemistry and organic chemistry.

110103211   Fundamentals of Analytical Chemistry: 3 CH. (3+0), Prerequisite: 110103102 or 1701081137

This course provides student with an introduction and review of some basic principles, errors in chemical analysis and statistical treatment of results, gravimetric methods of analysis, volumetric methods of analysis, aqueous solution chemistry and the various types of equilibria in analytical

chemistry, activity and activity coefficient, acid–base titrations, precipitation titrations, complex–formation titration and redox titrations.

110103213   Practical Analytical Chemistry: 1 CH. (0+3), Prerequisite: 110103211 or concurrently and 110103105 or 110103108

The course includes selected experiments to illustrate gravimetric analysis, various types of titrimetric methods of analysis as well as some chromatographic methods. It also put emphasis on the statistical treatment of data.

110103221   Inorganic Chemistry (1): 3 CH. (3+0), Prerequisite: 110103102

This course is an introductory course in inorganic chemistry. It covers areas such as atomic structure, ionic bonding, covalent bonding, bond energies, bonding and structures, reactivity, chemical forces, acid-base chemistry and chemistry in aqueous and non-aqueous solutions.

110103231   Organic Chemistry (1): 3 CH. (3+0), Prerequisite: 110103102

This course introduces students to the principles of nomenclature, isomerism, preparative methods, reactions, and mechanisms (substitution, addition, and elimination) of: alkanes and cycloalkanes, alkenes, alkynes stereochemistry and optical activity, alkyl halides and alcohols and ethers. It also describes alcohols from carbonyl compounds, oxidation–reduction and organometallic compounds.

110103232   Organic Chemistry (2): 3 CH. (3+0), Prerequisite: 110103231

This course describes the fundamentals of spectroscopic methods of structure determination (IR, UV, NMR, MS), conjugated unsaturated systems, aromatic compounds and their reactions, aldehydes and ketones, carboxylic acids and their derivatives, amines, phenols and aryl halides and nucleophilic aromatic substitution .

110103235   Organic Chemistry Laboratory (1): 2 CH. (1+3), Prerequisite: 110103232 or concurrently and 110103105

The course comprises basic techniques used in the separation and purification of organic compounds and determination of physical constants such as melting point determination, crystallization, distillation, extraction, and chromatography. It also describes simple preparative experiments and qualitative test for selected classes of organic compounds.

110103236   Basics of Organic Chemistry: 3 CH. (3+0), Prerequisite: 1701081138 or 1701081137

The course is offered for biology students in order to give a brief survey of concepts and functional groups in organic chemistry, including structure and bonding, aliphatic and aromatic hydrocarbons, alkyl halides, alcohols, phenols, carbonyl compounds, carboxylic acids and their derivatives and

amines. Also, the course includes an introduction to lipids, carbohydrates, amino acids and proteins.

110103237   Basics of Organic Chemistry for Medicine: 3 CH. (3+0):

The course is designed for medicine students in order to give a brief survey of concepts and functional groups in organic chemistry, including structure and bonding, aliphatic and aromatic hydrocarbons, alkyl halides, alcohols, phenols, carbonyl compounds, carboxylic acids and their derivatives and amines. In addition, the course includes an introduction to lipids, carbohydrates, amino acids and proteins.

110103241   Physical Chemistry (1): 3 CH. (3+0), Prerequisite: 110103102 and 110101102

This course provides students with required information about ideal and non-ideal gases, equations of state, kinetic molecular theory of gases and Maxwell distribution of molecular speeds. Also, it describes laws of chemical thermodynamics and their applications, solutions and partial molar quantities, phase equilibria and the phase rule for pure substances and mixtures and chemical equilibrium.

110103311   Instrumental Analysis (1): 3 CH. (3+0), Prerequisite: 110103211, 110103213, and 110103102

This course covers basic principles of instrumentation such as instrument components, calibration methods, and signal-to-noise ratio. It also covers the theoretical principles, detailed instrument components and analytical applications of the following spectral methods of analysis: atomic absorption, atomic emission, UV-visible molecular absorption, infrared absorption as well as molecular luminescence.

110103312   Instrumental Analysis (2): 3 CH. (2+3), Prerequisite: 110103311

This course covers the theoretical principles, detailed instrument components, and analytical applications of instrumental analytical techniques such as: chromatographic separation, gas-liquid chromatography, high performance liquid chromatography, ion-exchange chromatography, ion chromatography, column chromatography and other separation techniques such as electrophoresis. It also covers some electroanalytical methods of analysis such as: potentiometry, electrogravimetry, coulometry, amperometry, amperometric titrations, voltammetry and polarography. Laboratory experiments will be carried out on some of these techniques.

110103313   Instrumental Analysis Lab.: 1 CH. (0+3), Prerequisite: 110103312 or concurrently

This course consists of a set of laboratory experiments in some instrumental techniques such as atomic absorption, atomic emission, UV-visible molecular absorption, infrared absorption as well as molecular luminescence.

110103321 Inorganic Chemistry (2): 3 CH. (3+0), Prerequisite: 110103221

This course introduces students with basics of theories of coordination compounds, chemistry of coordination compounds, Structures of coordination compounds, different coordination numbers, isomerism in coordination chemistry, electronic spectra of transition metal complexes, chelate effect, trans effect, kinetics and mechanisms of coordination chemistry reactions.

110103325   Inorganic Chemistry Laboratory: 3 CH. (1+5), Prerequisite: 110103321 and 110103105

This laboratory course deals with the preparations and physical and chemical properties of transition metal complexes. Compounds are prepared and their spectral, magnetic, conductivity and chemical properties are examined. In all cases, the compounds are analyzed after preparation. This course relies considerably on instrumental analysis and illustrates principles encountered in 0103321.

110103331   Spectroscopy of Organic Compounds: 3CH (3+0), Prerequisite: 110103232

General principles of spectroscopy are introduced. Different spectroscopic methods which are used for structure determination of organic compounds are described. These methods include ultraviolet (UV) and visible spectroscopy, infra-red (IR) spectroscopy, ^{1}H and ^{13}C nuclear magnetic resonance (NMR) spectroscopy and mass spectrometry (MS). Combination of the information obtained using the different methods is given to teach the student how spectroscopic methods are used to solve complex structural problems and investigating bonding features in organic molecules.

110103335   Identification of Organic Compounds: 4 CH. (2+5), Prerequisite: 110103235

The course covers multistep synthesis of selected organic compounds, classification tests for detection of functional groups and identification of unknown organic compounds by physical, chemical, and spectroscopic technique as well as by the preparation of derivatives. The course also includes series of lectures related to the theoretical aspects of the experimental parts noted above and discusses how to solve various problems sets.

110103341   Physical Chemistry (2): 3 CH. (3+0), Prerequisite: 110103241 and 110103221

This course deals with concepts of equilibrium in non-ideal systems, equilibrium in electrochemical cells, activity, and activity coefficient for these systems, Debye-Huckel theory, electrode process, type of cells and cell potential. It also discusses transport properties and determination of transport number. In addition, the course elucidates the rate and order of

chemical reactions, theories of chemical reactions, type of chemical reactions, ionic reactions, catalysis, surface chemistry and colloids and colloidal properties of solutions.

110103342   Physical Chemistry (3): 2 CH. (2+0), Prerequisite: 110101203 or concurrently, and 110103341

This course introduces quantum mechanics. It also describes the postulates of quantum mechanics, solution of Schrodinger equation, operators in quantum mechanics, particle in a box, harmonic oscillator, rigid rotor, angular momentum, approximation methods (variation and perturbation) the hydrogen atom, orbital angular momentum and magnetic field, molecular systems and vibrational rotational spectroscopy.

110103345   Physical Chemistry Laboratory (1): 3 CH. (1+2x3), Prerequisite: 110103342 or concurrently

This course consists of approximately 30 laboratory sessions designed to illustrate the principles discussed in (0103241, 0103341 and 0103342). The experimental topics range over a wide variety of subjects such as: Partial molar quantities, determination of reaction enthalpies, the phase rule, electrochemistry, spectroscopy, kinetics, surface chemistry and photochemistry.

110103412   Environmental Analytical Chemistry: 3 CH. (3+0), Prerequisite: 110103311

The course introduces the basics of environmental chemistry. The topics cover biogeochemical cycles of sulfur, nitrogen, oxygen, carbon, and trace metals. The course also includes selected environmental problems of global concern such as acid rain, greenhouse effect, depletion of stratospheric ozone, and nuclear winter. Recent analytical methods for the determination of pollutants in water and atmosphere will be described.

110103413   Industrial Analysis: 3 CH. (2+3), Prerequisite: 110103311

The course covers subjects dealing with industrial analyses like validation in pharmaceutical and food industries, documentation types and documenting industrial analyses regarding quality, quality control and quality assurance. In addition, it explains detailed validation studies for instruments used in analysis and full validation for instrumental methods along with stability and stress studies and the required statistical evaluation. The course also describes methods of sample dissolution and preparation as well as analysis of pharmaceutical samples, foods and drinks, fertilizers, insecticides, water and pollutants.

110103421   Inorganic Chemistry (3): 3 CH. (3+0), Prerequisite: 110103321

This course includes topics such as symmetry, point groups and their applications especially in vibrational spectroscopy-cluster compounds-kinetics and mechanisms of inorganic reactions, chemistry of the halogens and noble gases and bioinorganic chemistry

110103422   Organometallic Chemistry: 3 CH. (3+0), Prerequisite: 110103321

This course covers wide range of subjects, which include metal-carbon bond and organometallic compounds of the main-group elements with the emphases on the organic compounds of lithium, magnesium, boron, aluminum, silicon and tin. The course also deals with organometallic compounds of transition metals, carbonyls, olefinic complexes, allylic complexes, butadiene complexes, h^5 –cyclopentadienyl complexes, h^6 – complexes of benzene organometallic compounds derived from acetylene and catalysis by organometallic compounds.

110103432   Organic Chemistry (3): 3 CH. (3+0), Prerequisite: 110103232

This course covers the following topics: reactions involving a–carbon of carbonyl compounds (enolate ions), b–Dicarbonyl compounds, lipids, carbohydrates, amino acids, proteins, nucleic acids, poly nuclear aromatic compound and heterocyclic compounds.

**110103433   Natural Products Chemistry: 3 CH. (3+0), Prerequisite: 110103232
          or concurrently.**

The course covers an introduction to the structure and biosynthesis of secondary metabolites including alkaloids, terpenoids flavones, vitamins, and a thiocyanins. In addition, it refers to the synthesis and biological activities of some of these compounds. Finally, the course discusses principles related to Chemistry and Ecology.

110103441   Molecular Spectroscopy: 3 CH. (3+0), Prerequisite: 110103342

This course combines the theoretical background and the physical aspects of subject with relation to the properties and structure of molecules. It includes the study of rotational and vibrational spectra (microwave, IR and Raman). In addition, it includes the study of electronic absorption and emission spectroscopy, symmetry and group theory and the calculations of modes of vibrations and applications.

110103444   Photochemistry: 3 CH. (3+0), Prerequisite: 110103342

This course deals with the theories of light and the strength of absorption, photochemical processes, quantum yield, and kinetics of photochemical reactions. The course also explains the fundamental of photophysics and photochemistry of atoms, diatomic molecules and polyatomic molecules, selection rules, franck-condon principle, energy transfer complexes, triplet state, phosphorescence, triplet-triplet transitions and lifetime. Furthermore, it covers several topics related to photochemical reactions such as triplet state, fluorescence, type of fluorescence, fluorescence lifetime, and fluorescence from excimers and exciplexes. Finally, the course discusses the following topics: chemiluminence, lasers and applications of lasers in chemistry.

**110103445   Electrochemistry and Corrosion: 3 CH. (3+0), Prerequisite:
          110103341**

This course discusses the principles of electrochemistry and its applications such as behavior of electrolyte solution, thermodynamics and kinetics of electrochemical reactions, electodeposition, electrocatalysis, batteries and fuel cells. The course also describes the basics of corrosion, electrochemical corrosion, and corrosion by acids, alkalis and pure water as well as the influence of environment on corrosion.

110103461   Industrial Chemistry: 3 CH. (3+0), Prerequisite: 110103232 and 110103321

This course includes the study of some inorganic and organic chemical industries such as acids, fertilizers, detergents, glass, pigments, cement and phosphate industries. In addition, the course studies the industry of fluorinated and chlorinated hydrocarbons, cellulose derivatives, polymers, leather, dyes and insecticides.

110103464   Polymer Chemistry: 3 CH. (3+0), Prerequisite: 110103232

This course introduces polymer science and technology synthesis. In addition, it describes the basics of thermodynamics and kinetics of polymerization, physical properties and structure, technological applications, methods for determination of molecular weights and thermal and photodegradation of polymers.

110103491   Seminar: 1 CH. (1+0), Prerequisite: 90 credits hours or more

This course is designed for fourth year students. Students are assigned original research topics by a staff member. They are supposed to work eight hours in the laboratory per week on a certain topic and to submit a report on the lab. Results are discussed at the end of the semester.

110103495   Special Topics in Organic and Inorganic Chemistry: 3 CH. (3+0), Prerequisite: 90 credits hours or more

The course includes special topics in Organic and Inorganic chemistry

110103496   Scientific Research: 3CH (3+0), Prerequisite: 90 credits hours or more

This course is designed to introduce the students with the ongoing research projects in the department and to train them on using the chemical literature. The students are supposed to perform a laboratory research assigned by a staff member and to submit a report about the results at the end of the semester.

110103497   Special Topics in Analytical and Physical Chemistry: 3 CH. (3+0), Prerequisite: 90 credits hours or more

The course includes special topics in Analytical and Physical chemistry

VI.IV. Department of Biology and Biotechnology
VI.IV.I. Introduction

Teaching in Department of Biology and Biotechnology started in the academic year 1995/1996. The department offers a flexible and challenging undergraduate program of study leading to Bachelor's degree in Biological Sciences and Bachelor's degree in Biotechnology. The minimum requirements for Bachelor in Biology or Biotechnology are 132 credit hours completed successfully according to the graduation plan. In 1999, postgraduate studies program in Biological Sciences was commenced; and distinguished postgraduates were granted scholarships to continue their Ph.D. abroad in branches that meet the department's future prospects and expansion. This policy has led to a vast growth in the department's academic staff. The department has become one of the largest scientific departments in the Faculty of Science with 19 faculty members, 8 technicians and 4 non-academic members. The department includes 10 teaching laboratories, 9 research laboratories, and 4 major accessory units that include:

1- The Microscopy Unit: The unit contains a transmission electron microscope and several advanced light microscopes for teaching and research purposes.
2- The Herbarium and Medical Garden Unit: The unit is used for the growth, classification, and storage of various plant species. Its library and laboratories fulfill both the teaching and research purposes of the department.
3- The Green House Unit: The unit provides the conditions required for research purposes and the growth of various plant species.
4- The Animal House Unit: The unit provides both teaching and research laboratories for the department and other faculties that require various animal species.

VI.IV.II. Requirements for Biology specialty

Eighty one (81) credit hours of coursework are required to fulfill the department requirements as follows:

VI.IV.II.ı. Compulsory courses

Sixty (60) credit hours of coursework are required to fulfill the department requirements:

Course No.	Course Title	Weekly Contact Hours		Credit Hours	Prerequisite
		Lecture	Practical		
110103102	General Chemistry (2)	3	0	3	1701081138
110103105	General Chemistry Laboratory	1	3	2	110103102 or concurrently
110103236	Basics of Organic Chemistry	3	0	3	1701081138 or 1701081137
1801041102	General Biology (2)	3	0	3	110108105
1801041103	Practical General Biology (1)	0	3	1	110108105 or concurrently
1801041104	Practical General Biology (2)	0	3	1	1801041102 or concurrently and 1801041103
1801041221	Genetics	2	3	3	1801041102

Course No.	Course Title	Lecture	Practical	Credit Hours	Prerequisite
1801041222	Biochemistry (1)	2	0	2	1801041102 and 110103236 or 110103232 or 1701081137
1801041223	Practical Biochemistry (1)	0	3	1	1801041222 or concurrently
1801042231	Cell Biology	2	0	2	110108105
1801041241	General Microbiology	2	3	3	1801041102
1801041251	Plant Biology	3	3	4	1801041102
1801041254	Plant Anatomy	2	3	3	1801041251
1801041263	Invertebrate Biology	2	3	3	1801041102
1801041264	Vertebrate Biology	2	3	3	1801041102
1801042322	Molecular Biology	2	0	2	1801041222
1801042324	Practical Molecular Biology	0	3	1	1801042322 or concurrently
1801041342	Mycology	2	3	3	1801041241
1801041351	Plant Physiology	2	3	3	1801041251
1801041361	Animal Physiology	2	3	3	1801041264
1801041362	Developmental Biology	2	0	2	1801041264
1801041364	Practical Developmental Biology	0	3	1	1801041362 or concurrently
1801041363	Immunology	2	3	3	1801041241
1801041371	Ecology	3	3	4	1801041264
1801041491	Seminar	1	0	1	passing 90 hours or more

VI.IV.II.II. Elective courses

A minimum of twenty one (21) credit hours of coursework are required according to the following list:

Course No.	Course Title	Weekly Contact Hours		Credit Hours	Prerequisite
		Lecture	Practical		
110102103	General Physics laboratory (1)	0	3	1	1701081136 or concurrently
110102104	General Physics laboratory (2)	0	3	1	110102102 or concurrently and 110102103
1801042233	Practical Cell Biology	0	3	1	1801042231 or concurrently
1801042321	Biotechnology	3	0	3	1801041241
1801041331	Histology	2	3	3	1801041102
1801041332	Microtechnique	1	3	2	1801041102

1801042341	Applied Microbiology	2	3	3	1801041241
1801042343	Virology	3	0	3	1801041241
1801041352	Plant Taxonomy	2	3	3	1801041251
1801042353	Economic Botany	3	0	3	1801041251 or 1801042252
1801041354	Medicinal plants	3	0	3	1801041251 or 1801042252
1801041355	Greenhouse Management	2	3	3	1801041251 or 1801042252
1801041365	Laboratory Animals	1	3	2	1801041102
1801042422	Modeling Biological systems	2	0	2	passing 90 hours or more
1801041452	Plant Reproductive biology	2	3	3	1801041251
1801041425	Biochemistry (2)	3	0	3	1801041222
1801042427	Experimental Design and Data Analysis	3	0	3	passing 90 hours or more
1801041454	Phycology	2	3	3	1801041102
1801041462	Evolution	3	0	3	1801041102
1801041463	Genetic Diversity	3	0	3	1801042322
1801041464	Animal Behavior	2	3	3	1801041361
1801041465	Marine Biology	3	0	3	1801041102
1801041466	Hematology	2	3	3	1801041361
1801041467	Parasitology	2	3	3	1801041263
1801042468	Cytogenetics	2	3	3	1801042322
1801042328	Preparation of Solutions and Culture Media	1	3	2	1801041102 and 110103105
1801042495	Special Topics	3	0	3	passing 90 hours or more

VI.IV.II.ɪɪɪ. Free elective courses
Students can choose any (3) Credit Hours course from courses offered by the University's faculties.

VI.IV.III. Requirements for Biotechnology specialty
Eighty one (81) credit hours of coursework are required to fulfill the department requirements as follows:

VI.IV.III.ɪ. Compulsory courses
Sixty three (63) credit hours of coursework are required to fulfill the department requirements:

Course No.	Course Title	Weekly Contact Hours		Credit Hours	Prerequisite
		Lecture	Practical		
110103236	Basics of organic Chemistry	3	0	3	1701081138 or 1701081137
1801041102	General Biology (2)	3	0	3	110108105
1801041103	Practical General Biology (1)	0	3	1	110108105 or concurrently
1801041104	Practical General Biology (2)	0	3	1	1801041102 or concurrently and 1801041103
1801041221	Genetics	2	3	3	1801041102
1801041222	Biochemistry (1)	2	0	2	1801041102 and (110103236 or 110103232 or 1701081137)
1801041223	Practical Biochemistry (1)	0	3	1	1801041222 or concurrently
1801042231	Cell Biology	2	0	2	110108105
1801042233	Practical Cell Biology	0	3	1	1801042231 or concurrently
1801041241	General Microbiology	2	3	3	1801041102
1801042252	Principles of Plant Biology	2	3	3	1801041102
1801042265	Functional Anatomy	2	3	3	1801041102
1801042321	Biotechnology	3	0	3	1801041241
1801042322	Molecular Biology	2	0	2	1801041222
1801042324	Practical Molecular Biology	0	3	1	1801042322 or concurrently
1801042323	Separation of Biological Molecules	2	3	3	1801041222
1801042325	Recombinant DNA Technology	1	6	3	1801042322
1801042326	Gene Expression	2	3	3	1801042322
1801042327	Plant Biotechnology	2	3	3	1801042252
1801042366	Applied Developmental Biology	2	3	3	1801042326
1801042422	Modeling Biological Systems	2	0	2	passing 90 hours or more
1801042424	Bioreactors	2	3	3	1801042321
1801042427	Experimental Design and Data Analysis	3	0	3	passing 90 hours or more

Course No.	Course Name	Lecture	Practical	Credit Hours	Prerequisite
1801042428	Fermentation	2	3	3	1801041241
1801042477	Bioinformatics	1	3	2	110108112 and18010423 21 and 1801042322
1801042496	Field Training	0	0	3	passing 75 hours or more

VI.IV.III.ɪɪ. Elective courses

A minimum of eighteen (18) credit hours of coursework are required according to the following list:

Course No.	Course Name	Weekly Contact Hours		Credit Hours	Prerequisite
		Lecture	Practical		
110102103	General Physics Laboratory (1)	0	3	1	1701081136 or concurrently
110103102	General Chemistry (2)	3	0	3	1701081138
110103105	General Chemistry laboratory	1	3	2	110103102or concurrently
1801042328	Preparation of Solutions and Culture Media	1	3	2	1801041102 and 110103105
1801042329	Pesticide Technology	3	0	3	1801041241
1801041332	Microtechniques	1	3	2	1801041102
1801042333	Animal Tissue Culture	2	3	3	1801041102
1801042336	Plant Tissue Culture	2	3	3	1801041251 or 1801042252
1801042341	Applied Miocrobiology	2	3	3	1801041241
1801041342	Mycology	2	3	3	1801041241
1801042343	Virology	3	0	3	1801041241
1801042353	Economic Botany	3	0	3	1801041251 or 1801042252
1801041354	Medicinal Plants	3	0	3	1801041251 or 1801042252
1801041363	Immunology	2	3	3	1801041241
1801041365	Laboratory Animals	1	3	2	1801041102
1801041425	Biochemistry (2)	3	0	3	1801041222
1801042426	Quality Control	2	0	2	1801041222
1801042429	Industrial and Pharmaceutical Biotechnology	2	0	2	1801041241 and 1801042321
1801042430	Forensic DNA Analysis	3	0	3	1801042322

1801042442	Diagnostic Microbiology	2	3	3	1801041241
1801042447	Microbial Genetics	2	3	3	1801041221 and 1801041241
1801041454	Phycology	2	3	3	1801041102
1801042468	Cytogenetics	2	3	3	1801042322
1801042495	Special topics	3	0	3	passing 90 hours or more
1801042423	Protein Biotechnology	2	0	2	1801042326
1801041491	Seminar	1	0	1	passing 90 hours or more

VI.IV.III.ɪɪɪ. Free elective courses

Students can choose any (3) credit hours course from courses offered by the University's faculties.

VI.IV.IV. Courses Offered by the department of Biology and Biotechnology

The following table represents the whole courses offered by the Department of Biology and Biotechnology:

Course No.	Course Title	Weekly Contact Hours		Credit Hours	Prerequisite
		Lecture	Practical		
110108105	General Biology (1)*	3	0	3	- Given by the department of basic sciences and taught by faculty members from Biology and biotechnology
110108113	Biotechnology and Society*	3	0	3	- Given by the department of basic sciences and taught by faculty members from Biology and biotechnology

1801041105	General Biology for Medical Science*	3	0	3	- Given by the Faculty of Applied Health Sciences and taught by faculty members from Biology and Biotechnology
1801041106	Practical General Biology for Medical Science*	3	0	3	- Given by the Faculty of Applied Health Sciences and taught by faculty members from Biology and Biotechnology
1801041102	General Biology (2)	3	0	3	110108105
1801041103	Practical General Biology (1)	0	3	1	110108105 or concurrently
1801041104	Practical General Biology (2)	0	3	1	1801041102 or concurrently and 1801041103
1801041221	Genetics	2	3	3	1801041102
1801041222	Biochemistry (1)	2	0	2	1801041102 and 110103236 or 110103232 or 1701081137
1801041223	Practical Biochemistry (1)	0	3	1	1801041222 or concurrently
1801042231	Cell Biology	2	0	2	110108105
1801041241	General Microbiology	2	3	3	1801041102
1801041251	Plant Biology	3	3	4	1801041102
1801041254	Plant Anatomy	2	3	3	1801041251
1801041263	Invertebrate Biology	2	3	3	1801041102
1801041264	Vertebrate Biology	2	3	3	1801041102
1801042322	Molecular Biology	2	0	2	1801041222
1801042324	Practical Molecular Biology	0	3	1	1801042322 or concurrently
1801041342	Mycology	2	3	3	1801041241
1801041351	Plant Physiology	2	3	3	1801041251
1801041361	Animal Physiology	2	3	3	1801041264
1801041362	Developmental Biology	2	0	2	1801041264
1801041364	Practical Developmental Biology	0	3	1	1801041362 or concurrently
1801041363	Immunology	2	3	3	1801041241

1801041371	Ecology	3	3	4	1801041264
1801041491	Seminar	1	0	1	passing 90 hours or more
1801042233	Practical Cell Biology	0	3	1	1801042231 or concurrently
1801042321	Biotechnology	3	0	3	1801041241
1801041331	Histology	2	3	3	1801041102
1801041332	Microtechnique	1	3	2	1801041102
1801042341	Applied Microbiology	2	3	3	1801041241
1801042343	Virology	3	0	3	1801041241
1801041352	Plant Taxonomy	2	3	3	1801041251
1801042353	Economic Botany	3	0	3	1801041251or 1801042252
1801041354	Medicinal plants	3	0	3	1801041251 or 1801042252
1801041355	Greenhouse Management	2	3	3	1801041251or 1801042252
1801041365	Laboratory Animals	1	3	2	1801041102
1801042422	Modeling Biological systems	2	0	2	passing 90 hours or more
1801041452	Plant Reproductive biology	2	3	3	1801041251
1801041425	Biochemistry (2)	3	0	3	1801041222
1801042427	Experimental Design and Data Analysis	3	0	3	passing 90 hours or more
1801041454	Phycology	2	3	3	1801041102
1801041462	Evolution	3	0	3	1801041102
1801041463	Genetic Diversity	3	0	3	1801042322
1801041464	Animal Behavior	2	3	3	1801041361
1801041465	Marine Biology	3	0	3	1801041102
1801041466	Hematology	2	3	3	1801041361
1801041467	Parasitology	2	3	3	1801041263
1801042468	Cytogenetics	2	3	3	1801042322
1801042328	Preparation of solutions and culture media	2	3	3	1801041102 and 110103105
1801042495	Special Topics	3	0	3	passing 90 hours or more
1801042252	Principles of Plant Science	2	3	3	1801041102
1801042265	Functional anatomy	2	3	3	1801041102
1801042323	Separation of Biological molecules	2	3	3	1801041222
1801042325	Recombinant DNA Technology	1	6	3	1801042322
1801042326	Gene Expression	2	3	3	1801042322
1801042327	Plant Biotechnology	2	3	3	1801042252
1801042329	Pesticide Technology	3	0	3	1801041241
1801042333	Animal Tissue Culture	2	3	3	1801041102
1801042336	Plant tissue culture	2	3	3	1801041251 or 1801042252

1801042366	Applied Developmental Biology	2	3	3	1801042326
1801042423	Protein Biotechnology	2	0	2	1801042326
1801042424	Bioreactors	2	3	3	1801042321
1801042426	Quality Control	2	0	2	1801041222
1801042428	Fermentation	2	3	3	1801041241
1801042429	Industrial and Pharmaceutical Biotechnology	2	0	2	1801041241 and 1801042321
1801042430	Forensic DNA Analysis	3	0	3	1801042322
1801042442	Diagnostic Microbiology	2	3	3	1801041241
1801042447	Microbial Genetics	2	3	3	1801041221 and 1801041241
1801042477	Bioinformatics	1	3	2	110108112 and 1801042321 and 1801042322
1801042496	Field Training				Passing 75 hours or more

* See Department of Basic Sciences for course description

VI.IV.V. Course descriptions for Biology specialty

1801041102   General Biology (2), 3 CH (3 +0), Prerequisite: 110108105

This course concentrates on the basic principles of animal form and function, homeostasis, metabolic rate, chemical signals, digestive systems, transport systems, defenses against infection, osmoregulation and excretion, reproductive systems, electrical signals, sensation and movement.

1801041103   Practical General Biology (1), 1 CH (0+3), Prerequisite: 110108105

The course provides students with practical aspects of general biology such as studying the light microscope and using it to identify cell types. It also explores the cell chemical and physical properties, metabolism, and modes of cell division. Moreover, it briefly studies plant anatomy and characteristics of different plant groups.

1801041104   Practical General Biology (2), 1 CH (0+3), Prerequisite: 1801041102 & 1801041103

The course studies the different types of animal tissues, and teaches the students how to practices dissection to study the structure and function of different animal organs. It also explores the main stages of animal development, animal diversity, and different animal groups.

1801041105   General Biology for Medical Science, 3 CH (3+0), Prerequisite: -

The course studies the basic principles of biological molecules, cell structure, cell membranes, cell respiration and cell division, as well as the basic information about human body structure and function.

1801041106   Practical General Biology for Medical Science, 1 CH (0+3), Prerequisite: 1801041105

The course practically explores the cell chemical and physical properties, metabolism, and modes of cell division. It also studies the different types of animal tissues using the light microscope. Moreover, it studies the structure and function of animal body as well as animal embryonic development and animal diversity.

1801041221   Genetics, 3 CH (2 +3), Prerequisite: 1801041102

This course covers the study of the basic principles of Mendelian genetics, statistical and family analysis, sex determination, linkage, cytogenetics, chromosomal aberration and molecular structure of the gene. Also, it explores the processes of replication, transcription and mutation and describes the fundamentals of population genetics

1801041222 Biochemistry I, 2 CH (2 +0), Prerequisite: 1801041102 & (110103236 or 110103232 or 1701081137)

This course introduces students to the principles of biochemistry by studying the molecular composition of the cell, proteins, enzymes, sugars, lipids, nucleic acids vitamins, coenzymes and enzymes.

1801041223 Practical Biochemistry 1, 1 CH (0+3), Prerequisite: 1801041222 or concurrently

This course aims to teach students the principles of safety and hazards in biochemistry laboratories. The first group of experiments in the course covers the fundamental techniques used in the analysis and construction of important titration curves for amino acids and some other dyes. In the second group of experiments, the students will learn how to identify, quantize and differentiate between different biochemical compounds.

1801042231   Cell Biology, 2 CH (2 +0), Prerequisite: 110108105

This course covers the basics of cell biology, including the ultrastructure and function of cell membrane, organelles structure and functions, nuclear envelope, structure and function of chromatids, replication, protein synthesis, structure, function of muscles and motility of cells.

1801042233   Practical Cell Biology, 1 CH (3 +0), Prerequisite: 1801042231 or concurrently

This practical course covers some techniques used in cell biology through performing experiments related to microscopic measurements of cells, plasma membrane and osmosis, cellular fractionation, chemistry of cells, cell division, cytoskeleton and extracellular matrix.

1801041241   General Microbiology, 3 CH (2+3), Prerequisite: 1801041102

This course studies the nature of microorganisms such as their structure, function, growth, interaction with the environment, metabolism, and genetics. It also studies viruses, fungi, cyanobacteria and different types of bacteria. In addition, it studies the relationship between different microorganisms, the ability of some of them to fix atmospheric nitrogen, the diseases caused by bacteria and the economic importance of microorganisms.

1801041251   Plant Biology, 4 CH (3+3), Prerequisite: 1801041102

This course studies the vascular and non-vascular plant divisions including: algae, liver worts, mosses and seedless and bearers vascular plants. It also explores the structure and function of different plant tissues such as meristematic, parenchyma, collenchyma, sclerenchyma, epidermis primary and secondary vascular tissue and vascular cambium. Finally, the course study the plant organs, their structure and function and their modification.

1801041254   Plant anatomy, 3 CH (2 +3), Prerequisite: 1801041251

This course explores the internal structure of the vascular plants, especially the angiosperms (flowering plants) with consideration of certain features of gymnosperms. It also studies the comparative structure and growth of meristems as well as the structure of important cell types, tissues and tissue systems. Furthermore, the course explores the comparative anatomy of the stem, root, leaf, flower, seed and fruit. In the practical part of the course, the students are taught the skills in specimen preparation for microscopic observation.

1801041263   Invertebrate Biology, 3 CH (2+3), Prerequisite: 1801041102

The course covers the basic principles of invertebrate biology and classification. It also discusses the main invertebrate phyla such as Proifera, Cnidarians, Platyhelminthes, Annelida, Mollusca, Arthropoda and Echinodermata.

1801041264   Vertebrate Biology, 3 CH (2+3), Prerequisite: 1801041102

This course involves practical, theoretical and field studies on the structures, functions and adaptations of fishes, amphibians, reptiles, mammals and birds. It also gives broad overview of vertebrate diversity, phylogeny and systematics.

1801042321   Biotechnology, 3 CH (3+ 0), Prerequisite: 1801041241

The course deals with the major elements of global significance of biotechnology, the categories of biotechnology processes and products, and the context of "classical" vs "modern" biotechnology processes. In addition, it describes the key developments in the history of biotechnology as well as the enabling technologies like fermentation, downstream processing, recombinant methods, analysis and automation, genomics, proteomics and metabolomics.

1801042322   Molecular Biology, 2 CH (2+0), Prerequisite: 1801041222

This course describes the nature of macromolecules (proteins and nucleic acids) and the interactions between them. The course also highlights various cellular activities carried out by the genetic material (DNA) such as DNA replication, transcription, translation, mutagenesis and mutations, and DNA repair mechanisms in both prokaryotes and eukaryotes.

1801042324   Practical Molecular Biology, 1 CH (0+3), Prerequisite: 180102322 or concurrently

The course focuses on understanding the various methods of DNA extraction as well as DNA measurement, purity and visualization. It also introduces the students to the techniques of DNA amplification and cDNA formation known as the polymerase chain reaction and reverse transcription reaction, respectively. The course focuses on the encountered troubleshooting.

1801042328   Preparation of solutions and culture media, 2 CH (1+3), Prerequisite: 1801041102 and 110103105

This course is an introduction to the theory, standard practices, and methodologies employed for solutions and culture preparation. Students receive hands-on laboratory experience including sterile techniques, media preparation, common buffers and solutions for our Life Sciences laboratories.

1801041331   Histology, 3 CH (2+3), Prerequisite: 1801041102

This course focuses on the microscopic study of tissues and the tissue organization of organs in relation to their function using light and electron microscopy. Tissue preparation for microscopic study, histochemistry, stains, and stain technology are slightly covered.

1801041332   Microtechnique, 2 CH (1+3), Prerequisite: 1801041102

This course provides students with the skills and knowledge to prepare slides from plant and animal tissues to be examined microscopically. Fixation, washing, dehydration, clearing, impregnation, embedding, microtomy, staining and mounting will be included.

1801042341   **Applied Microbiology, 3 CH (2+3), Prerequisite: 1801041241**

The course covers the microbial metabolic processes that can be utilized for commercial and nutritional purposes. These processes include food preservation by chemical and physical factors, food spoilage, contamination of food by microorganisms and production of some types of food.

1801041342   **Mycology, 3 CH (2+3), Prerequisite: 1801041241**

This course focuses on studying the general characteristic of fungi, their classification, structure, reproduction, physiology and economical and industrial importance.

1801042343   **Virology, 3 CH (3+0), Prerequisite: 1801041241**

This course put emphases on understanding the nature of viruses, their interactions with host cells, replication, gene expression and latency. The course also highlights the various viral families involved in diseases and the different cultivation and detection methods.

1801041351   **Plant Physiology, 3 CH (2+3), Prerequisite: 1801041251**

The course emphasizes the importance of photosynthesis, gas exchange, plant water relationship, soil as a nutrient reservoir, plants inorganic nutrients, the role of hormones in plant development and environmental stress responses.

1801041352   **Plant Taxonomy, 3 CH (2+3), Prerequisite: 1801041251**

This course introduces students to the basic rules of plant systematics, brief history of this science, terminology used in describing plants, methods of collecting plants and conserving them in the herbarium, plant nomenclature, principles of plant taxonomy, methods of preparing and using identification keys. The course also studies characteristics of some plant families especially the common plant families in Jordan flora.

1801042353   **Economic Botany 3 CH (3+0), Prerequisite: 1801041251 or 1801042252**

Economic botany explores the importance and nature of plant products in our lives. The course also covers the use of plants as a source of food (cereals, legumes, nuts, vegetables, fruits, spices and other flavouring materials) and as source of beverages and textiles. Moreover, the course focuses on plant products of industrial value (fibres, wood, cork, rubber, tannin gums, resins and vegetable oils). Finally, it gives a brief idea about the use of plants as medicines and the use of plants in ornamental gardening.

1801041354   **Medicinal plants, 3 CH (3+0), Prerequisite: 1801041251 or 1801042252**

This course focuses on the medicinal properties of plants and their role in both traditional and modern medicine as one type of the alternative medicine, with special emphasis on the commonly used plants in Jordan. The course also describes the history of herbal medicine, the active constituents of medicinal plants and the preparation of some herbal remedies. In addition, it studies some nervous system stimulant plants (psychoactive drugs).

1801041355   Greenhouse Management, 3 CH (2+3), Prerequisite: 1801041251 or 1801042252

This course describes the principles of greenhouse operation, management practices involved in greenhouse structures and construction, site considerations, covering materials, heating and cooling systems as well as greenhouse crop production techniques in order to produce commercial plant species in a controlled environment. The course also applies cultural practices as they affect plant physiological processes and influence plant growth and development.

1801041361   Animal Physiology, 3 CH (2+3), Prerequisite: 1801041264

This course analyzes current concepts and molecular details of modern systems in physiology through lecture, discussion and writing assignments. Emphasis will be placed on understanding the mechanisms used by the organ systems (skeletal, muscular, endocrine, excretory, respiratory, circulatory, digestive and nervous systems) of different animals to maintain homeostasis.

1801041362   Developmental Biology, 2 CH (2+0), Prerequisite: 1801041264

This course focuses on studying the basic principles of differentiation and morphogenesis, starting from gametogenesis, fertilization, cleavage, gastrulation, and organogenesis. The development of the embryonic germ layers of deuterostome embryos will be covered as well.

1801041363   Immunology, 3 CH (3+2), Prerequisite: 1801041241

This discipline is concerned with the study of the immune system of humans that has evolved to protect against infection by pathogens. The course provides a basic understanding of human immunology and its relationship to health and disease. The course aims to provide students with an appreciation of the relationship between immunology and other biology desciplines while providing knowledge of the molecular and cellular basis of the immune system. The course discusses as well the principals of immunological treatments including anti-inflammatory, anti-cancer, immunosuppressive, vaccines and antigen and antibody-based treatment.

1801041364   Practical Developmental Biology, 1 CH (0+3), Prerequisite: 1801041362 or concurrently

This course illustrates the processes, concepts, and principles discussed in Developmental Biology course, through investigative activities that emphasize the interdisciplinary approach of Developmental Biology. Lab exercises include dissection of male and female rats, studying the menstrual cycle of female mice, fertilization, cleavage, and gastrulation of three model organisms; sea urchin, frog and chicken. In addition, the exercises cover the development of certain organs in the chick embryo.

1801041365   Laboratory Animals, 2 CH (1+3), Prerequisite: 1801041102

The course provides training on the use of laboratory animals. The lectures will include legislation, ethics, handling and husbandry of common laboratory animals, diseases and disease prevention, basic concept of laboratory animal breeding and genetics, anesthesia, analgesia and euthanasia of laboratory animals and basic surgical techniques. In addition, the course covers research planning, animal models and humane endpoints, allergy to laboratory animals and other occupational hazards working with laboratory animals.

1801041371   Ecology, 4 CH (3 +3), Prerequisite: 1801041264

The course covers the principles of ecology, the geochemocycles and man, energy and food cycles, aquatic ecosystem, terrestrial ecosystems, communities, populations and biosphere and relating all of the above to Jordan's ecology.

1801042422   Modeling Biological Systems, 2 CH (2 +0), Prerequisite: passing 90 hours or more

The course covers the modeling of biological processes, including deterministic and stochastic processes. The course also emphasizes on the development and construction of working models and the interpretation of results. Students are directed to develop their own models of a real – world biological process.

1801041425   Biochemistry (2), 3 CH (3+0), Prerequisite: 1801041222

The course covers several topics such as carbohydrates, fatty acids and amino acids oxidation, anabolism and catabolism of nucleotides, biochemistry of hormones transport and effects on metabolism.

1801042427   Experimental Design and Data Analysis, 3 CH (3 +0), Prerequisite: passing 90 hours or more

This course explains the basic principles of designing experiments for biological applications including sample collection and the most used experimental designs in biological sciences. Emphases on the role of statistical tools in analyzing and interpreting biological data will be covered.

1801041452   Plant Reproductive Biology, 3 CH (2+3), Prerequisite: 1801041251

The aim of this course is to familiarize the student with the genetic mechanisms responsible for the differences in plant reproductive biology and how to use the advantages of these differences in the plant propagation. The course includes the following topics: Composition and function of the flower, composition of pollen grains, their forms and functions, multiplicity of fertilization, composition of seeds and their forms and functions. The course also describes self-pollination in the plant and the mechanisms that prevent its occurrence in other plants, the mechanisms of asexual reproduction in plants, vegetative reproduction and agriculture, plant biotechnology and controversy. Furthermore, it elucidates the characteristics of plant life history, its role in the phenomenon of plant spread and biological invasion and the negative effects on indigenous plant species

1801041454   Phycology, 3 CH (2+3), Prerequisite: 1801041102

This course introduces the ecological and economic significance of algae. The underlying principles of algal growth and their response to light, temperature, and nutrients are examined. The potential of algae to provide raw material for the biotechnological industry is reviewed. In addition, the harmful effects of algae and means of mitigation, algae for biofuel, microalgae for food, use of algae in nanotechnology and high value products from algae are discussed.

1801041462   Evolution, 3 CH (3+0), Prerequisite: 1801041102

This course describes the different schools of evolutionary thoughts and compares between them. In addition, it explains the different steps that led to the emergence of life as well as the different methods used to date the ancient fossils. The course aims to support the theory of evolution through presenting different evidences and examples from nature. Moreover, it differentiates between the mechanisms of evolution by means of artificial or natural selection and compares between the different patterns underlying species formation. Finally, the course demonstrates the consequences of living in groups and formulates the gradual steps that led to the evolution of modern humans.

1801041463   Genetic diversity, 3 CH (3+0), Prerequisite: 1801042322

This course describes the tool kit genes that determine the anterior-posterior and dorsal- ventral body axes during the early embryo development. Then, it elucidates the effect of tool kit genes in the growth and differentiation of different body organs. The course also explains the mechanisms underlying the evolution of expression patterns of tool kit genes in different organisms and demonstrates how these patterns diverged from the expression patterns in *Drosophila*. Moreover, the course elucidates the processes underlying the evolution of morphological novelties through changes in the regulation of developmental genes expression. Finally, the course explains the effect of environmental cues in the production of different phenotypes from the same genotype.

1801041464   Animal Behavior, 3 CH (2+3), Prerequisite: 1801041361

This course covers the scientific study of the mechanistic and evolutionary causes of animal behavior, including communication, foraging and anti-predator behavior, spatial behavior, mating behavior, parental care and social behavior.

1801041465   Marine Biology, 3 CH (3+0), Prerequisite: 1801041102

This course covers the physical structure, the organisms and the processes of the oceans, from intertidal to deep-sea habitats. To understand the environments faced by marine biological diversity, the course will survey the chemical and physical properties of oceans and their habitats. The structure, adaptations, and life styles of organisms found over the range of habitats in the sea will be surveyed. The course will examine major marine habitats. Marine ecology will be the focus to learn about the processes affecting marine communities, and the dynamics of communities. Special topics incorporated into the course will include current issues in marine environmental management and conservation.

1801041466   Haematology, 3 CH (2+3), Prerequisite: 1801041361

The course introduces the composition and function of blood cells, hematopoiesis, erythrocyte and leukocyte metabolism, production and destruction, classification of anemias and leukemias, etiology and laboratory findings. Mechanisms and tests of hemostasis (blood clotting) in normal versus patients with hemorrhagic or thrombotic diseases are also studied

1801041467   Parasitology, 3 CH (2+3), Prerequisite: 1801041263

This course is designed to give a broad overview of general parasitology, with respect to types of parasites, nature of parasitism, advantages and disadvantages of parasitism. The course includes the life cycle of some common parasites of man and animals and epidemiology of tropical Parasites.

1801042468   Cytogenetics, 3 CH (2+3), Prerequisite: 1801042322

This course covers chromosome structure and function and studies the role of chromosomes in human disease. Topics that are covered include cytogenetic methodology, types of chromosome aberration, chromosomes and cancer, chromosome breakage syndromes and fragile sites on human chromosomes.

1801041491   Seminar, 1 CH (1+0), Prerequisite: passing 90 hours or more

This course provides a forum for students to discuss a research article in one of the various fields of Biology or Biotechnology. Students choose an in-depth research topics of their choice, present and discuss them with other students under the supervision of a faculty member.

1801042495   **Special topics, 3 CH (3+0) Prerequisites: Student has finished 90 credit hours or more**

This course studies a new topic in biology or biotechnology that is prepared by a faculty member and subjected to the department approval.

VI.IV.VI. Course descriptions for Biotechnology specialty

1801041102   **General Biology (2), 3 CH (3 +0), Prerequisite: 110108105**

This course concentrates on the basic principles of animal form and function, homeostasis, metabolic rate, chemical signals, digestive systems, transport systems, defenses against infection, osmoregulation and excretion, reproductive systems, electrical signals, sensation and movement.

1801041103   **Practical General Biology (1), 1 CH (0+3), Prerequisite: 110108105**

The course provides students with practical aspects of general biology such as studying the light microscope and using it to identify cell types. It also explores the cell chemical and physical properties, metabolism, and modes of cell division. Moreover, it briefly studies plant anatomy and characteristics of different plant groups.

1801041104   **Practical General Biology (2), 1 CH (0+3), Prerequisite: 1801041102 & 1801041103**

The course studies the different types of animal tissues, and teaches the students how to practices dissection to study the structure and function of different animal organs. It also explores the main stages of animal development, animal diversity, and different animal groups.

1801041221   **Genetics, 3 CH (2 +3), Prerequisite: 1801041102**

This course covers the study of the basic principles of Mendelian genetics, statistical and family analysis, sex determination, linkage, cytogenetics, chromosomal aberration and molecular structure of the gene. Also, it explores the processes of replication, transcription and mutation and describes the fundamentals of population genetics

1801041222   **Biochemistry I, 2 CH (2 +0), Prerequisite: 1801041102 & (110103236 or 110103232 or 1701081137)**

This course introduces students to the principles of biochemistry by studying the molecular composition of the cell, proteins, enzymes, sugars, lipids, nucleic acids vitamins, coenzymes and enzymes.

1801041223   **Practical Biochemistry 1, 1 CH (0+3), Prerequisite: 1801041222 or concurrently**

This course aims to teach students the principles of safety and hazards in biochemistry laboratories. The first group of experiments in the course covers the fundamental techniques used in the analysis and construction of important titration curves for amino acids and some other dyes. In the second group of experiments, the students will learn how to identify, quantize and differentiate between different biochemical compounds.

1801042231   Cell Biology, 2 CH (2 +0), Prerequisite: 110108105

This course covers the basics of cell biology, including the ultrastructure and function of cell membrane, organelles structure and functions, nuclear envelope, structure and function of chromatids, replication, protein synthesis, structure, function of muscles and motility of cells.

1801042233 Practical Cell Biology, 1 CH (3 +0), Prerequisite: 1801042231 or concurrently

This practical course covers some techniques used in cell biology through performing experiments related to microscopic measurements of cells, plasma membrane and osmosis, cellular fractionation, chemistry of cells, cell division, cytoskeleton and extracellular matrix.

1801041241   General Microbiology, 3 CH (2+3), Prerequisite: 1801041102

This course studies the nature of microorganisms such as their structure, function, growth, interaction with the environment, metabolism, and genetics. It also studies viruses, fungi, cyanobacteria and different types of bacteria. In addition, it studies the relationship between different microorganisms, the ability of some of them to fix atmospheric nitrogen, the diseases caused by bacteria and the economic importance of microorganisms.

1801042252   Principles of Plant Science, 3 CH (2 +3), Prerequisite: 1801041102

The course provides the students with the principles of production and adaptation of cultivated plants. It also focuses on gaining general knowledge about plant growth, reproduction, anatomy, physiology, water and nutrient management. In addition, it provides an overview about the factors affecting development, propagation, management and utilization of plants.

1801042265   Functional anatomy, 3 CH (2+3), Prerequisite: 1801041102

This course covers the normal physiology of the human body. It includes topics on metabolism, digestion, osmoregulation, excretion, respiration, circulation, muscles, neurophysiology, sense organs, immunology, endocrinology and reproduction. Emphasis will be placed on understanding the mechanisms used by these systems to maintain homeostasis.

1801042321   Biotechnology, 3 CH (3+ 0), Prerequisite: 1801041241

The course deals with the major elements of global significance of biotechnology, the categories of biotechnology processes and products, and the context of "classical" vs "modern" biotechnology processes. In addition, it describes the key developments in the history of biotechnology as well as the enabling technologies like fermentation, downstream processing, recombinant methods, analysis and automation, genomics, proteomics and metabolomics.

1801042322   Molecular Biology, 2 CH (2+0), Prerequisite: 1801041222

This course describes the nature of macromolecules (proteins and nucleic acids) and the interactions between them. The course also highlights various cellular activities carried out by the genetic material (DNA) such as DNA replication, transcription, translation, mutagenesis and mutations, and DNA repair mechanisms in both prokaryotes and eukaryotes.

1801042323   Separation of Biological molecules, 3CH (2+3), Prerequisite: 1801041222

This is an introductory-level course designed to acquaint the students with the wide range of modern techniques available for separating and purifying biomolecules. The fundamentals of each technique will be presented, including practical examples.

1801042324   Practical Molecular Biology, 1 CH (0+3), Prerequisite: 180102322 or concurrently

The course focuses on understanding the various methods of DNA extraction as well as DNA measurement, purity and visualization. It also introduces the students to the techniques of DNA amplification and cDNA formation known as the polymerase chain reaction and reverse transcription reaction, respectively. The course puts emphases on the encountered troubleshooting.

1801042325   Recombinant DNA Technology, 3 CH (1+6), Prerequisite: 1801042322

This course will provide students with an introduction to modern molecular biology techniques, specifically recombination techniques including DNA and plasmid isolation from eukaryotic and prokaryotic cells, DNA purification, restriction digest and gel electrophoresis, bacterial transformation, reverse transcription, polymerase chain reaction (PCR and RT-PCR) and cloning DNA fragments. The lectures and assigned readings will cover the theory and experimental applications of these molecular techniques.

1801042326   Gene Expression, 3 CH (2+3), Prerequisite: 1801042322

This course studies the mechanisms of genome condensation and the flow of genetic information from DNA in the nucleus to proteins in the cytoplasm. In addition, it explores the processes of gene expression regulation in prokaryotic and eukaryotic cells as well as the mechanisms of post-transcriptional control in eukaryotes. Furthermore, the course elucidates the methods of cell cycle regulation in eukaryotes. The practical part of the course focuses on performing different procedures related to genetic material isolation and gene expression detection.

1801042327   Plant Biotechnology, 3 CH (2+3), Prerequisite: 1801042252

This course focuses on studying modern techniques used for propagation of medically, economically and environmentally important plants.

1801042328   Preparation of Solutions and Culture Media, 2 CH (1+3), Prerequisite: 1801041102 and 110103105

This course is an introduction to the theory, standard practices, and methodologies employed for solutions and culture preparation. Students receive hands-on laboratory experience including sterile techniques, media preparation, common buffers and solutions for our Life Sciences laboratories.

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1801042329   Pesticide Technology, 3 CH (3+0), Prerequisite: 1801041241

The course emphasizes the overall approach of applying intelligent and efficient interface with pest and safe use of poison. The course includes principles for disease control, the application of the principles of pest control and soil pest control. In addition, the course introduces the student to the broad field of pest control in agriculture and various pesticide application methods and technologies.

1801041332   Microtechnique, 2 CH (1+3), Prerequisite: 1801041102

This course provides students with the skills and knowledge to prepare slides from plant and animal tissues to be examine microscopically. Fixation, washing, dehydration, clearing, impregnation, embedding, microtomy, staining and mounting will be included.

1801042333   Animal Tissue Culture, 3 CH (2+3), Prerequisite: 1801041102

This course will cover the basic theories and principles of growing animal cells by tissue culture techniques. Methods of determining growing media for each cell type, appropriate procedures for different equipment and media sterilization and management of environmental control and equipment used in tissue culture laboratory will be discussed.

1801042336 Plant tissue culture, 3 CH (2+3), Prerequisite: 1801041251 or 1801042252

This course covers information on in vitro culture of higher plants, including preparation of the nutrient media, how to make plant embryos, how to produce cells and calluses, production of disease-free plants and protoplast production and applications.

1801042341   Applied Microbiology, 3 CH (3+2), Prerequisite: 1801041241

The course covers the microbial metabolic processes that can be utilized for commercial and nutritional purposes. These processes include food preservation by chemical and physical factors, food spoilage, contamination of food by microorganisms and production of some types of food.

1801041342   Mycology, 3 CH (2+3), Prerequisite: 1801041241

This course focuses on studying the general characteristic of fungi, their classification, structure, reproduction, physiology and economical and industrial importance.

1801042343   Virology, 3 CH (3+0), Prerequisite: 1801041241

This course put emphases on understanding the nature of viruses, their interactions with host cells, replication, gene expression and latency. The course also highlights the various viral families involved in diseases and the different cultivation and detection methods.

1801042353   Economic Botany 3 CH (3+0), Prerequisite: 1801041251 or 1801042252

Economic botany explores the importance and nature of plant products in our lives. The course also covers the use of plants as a source of food (cereals, legumes, nuts, vegetables, fruits, spices and other flavouring materials) and as source of beverages and textiles. Moreover, the course focuses on plant products of industrial value (fibres, wood, cork, rubber, tannin gums, resins and vegetable oils). Finally, it gives a brief idea about the use of plants as medicines and the use of plants in ornamental gardening.

1801041354   Medicinal plants, 3 CH (3+0), Prerequisite: 1801041251 or 1801042252

This course focuses on the medicinal properties of plants and their role in both traditional and modern medicine as one type of the alternative medicine, with special emphasis on the commonly used plants in Jordan. The course also describes the history of herbal medicine, the active constituents of medicinal plants and the preparation of some herbal remedies. In addition, it studies some nervous system stimulant plants (psychoactive drugs).

1801041363   Immunology, 3 CH (3+2), Prerequisite: 1801041241

This discipline is concerned with the study of the immune system of humans that has evolved to protect against infection by pathogens. The course provides a basic understanding of human immunology and its relationship to health and disease. The course aims to provide students with an appreciation of the relationship between immunology and other biology desciplines while providing knowledge of the molecular and cellular basis of the immune system. The course discusses as well the principals of immunological treatments including anti-inflammatory, anti-cancer, immunosuppressive, vaccines and antigen and antibody-based treatment.

1801041365   Laboratory Animals, 2 CH (1+3), Prerequisite: 1801041102

The course provides training on the use of laboratory animals. The lectures will include legislation, ethics, handling and husbandry of common laboratory animals, diseases and disease prevention, basic concept of laboratory animal breeding and genetics, anesthesia, analgesia and euthanasia of laboratory animals and basic surgical techniques. In addition, the course covers research planning, animal models and humane endpoints, allergy to laboratory animals and other occupational hazards working with laboratory animals.

1801042366   Applied Developmental Biology, 3 CH (2+3), Prerequisite: 1801042326

The study of the events that result in the development of the single-celled egg to a multicellular adult vertebrate organism. A special focus will be given to gametogenesis, tissue interactions and organogenesis and genetic control of cell differentiation. New advances in developmental biology such as stem cell research and in vitro fertilization will be discussed.

1801042422   Modeling Biological Systems, 2 CH (2 +0), Prerequisite: passing 90 hours or more

The course covers the modeling of biological processes, including deterministic and stochastic processes. The course also emphasizes on the development and construction of working models and the interpretation of results. Students are directed to develop their own models of a real – world biological process.

1801042423   Protein Biotechnology, 2 CH (2+0), Prerequisite: 1801042326

The course will cover applied aspects of protein chemistry in biotechnology and protein design. Topics covered will include applications of modern analytical and biophysical techniques used in proteomics and related biochemical analyses and protein structure design.

1801042424   Bioreactors, 3 CH (2+3), Prerequisite: 1801042321

This course considers the heart of bioprocesses. It presents all aspects that are relevant to bioreactors and provides adequate knowledge about the bioreactors at laboratory and industrial levels. This course provides

knowledge about analysis, calculations, construction and application of bioreactors in biotechnology.

1801041425 Biochemistry (2), 3 CH (3+0), Prerequisite: 1801041222

The course covers several topics such as carbohydrates, fatty acids and amino acids oxidation, anabolism and catabolism of nucleotides, biochemistry of hormones transport and effects on metabolism.

1801042426 Quality Control, 2 CH (2 +0), Prerequisite: 1801041222

The course covers the basics of quality control and quality assurance with emphasis on the importance of following quality control procedures in laboratories.

1801042427 Experimental Design and Data Analysis, 3 CH (3 +0), Prerequisite: passing 90 hours or more

This course explains the basic principles of designing experiments for biological applications including sample collection and the most used experimental designs in biological sciences. Emphases on the role of statistical tools in analyzing and interpreting biological data will be covered.

1801042428 Fermentation, 3 CH (2+3), Prerequisite: 1801041241

This course describes the basic principles of fermentation as a technology for the production of value-added products. This course provides enough information about growth kinetics, process operation, downstream processing and effluent treatment.

1801042429 Industrial and Pharmaceutical Biotechnology, 2 CH (2+0), Prerequisite: 1801041241 & 1801042321

The course introduces students to subjects such as immunobiotechnology, production, manufacturing and registration of biological drugs and bioprocess engineering and technology. In addition, it covers the basics of using enzymes and microbes for the manufacturing of products which have a huge industrial significance. This in turn will enable students to work in pharmaceutical and Research and Development (R&D) companies as well as food and biofuel industry.

1801042430 Forensic DNA Analysis, 3 CH (3+0), Prerequisite: 1801042322

The course focuses on methods of DNA analysis in criminal investigations to identify perpetrators and victims and assist in individualization or kinship. The course covers the methods of studying the crime scene and dealing with the various criminal samples as well as the methods of analysis using the series of repeated nitrogen bases and mutations or changes in the nitrogen bases in the cellular and mitochondrial DNA. This helps the students to understand the latest techniques used in solving or finding answers to criminal cases.

1801042442   Diagnostic Microbiology, 3 CH (2+3), Prerequisite: 1801041241

This course focuses on the major groups of the medically important bacteria and the criteria used in differentiation and classification of pathogenic bacteria. In addition, it discusses the medical importance of different pathogenic bacteria to humans and studies the etiological characteristic, the pathogenicity and the clinical manifestation. Students will have practical training on the bacterial isolation techniques, identification from different body samples, along with a look at the concepts and methodologies of bacterial sensitivity tests.

1801042447   Microbial Genetics, 3 CH (2+3), Prerequisite: 1801041221 and 1801041241

The course examines the transmission of heritable traits by microbes and the methods and principles used to study inheritance. The course also explores how knowledge of natural genetic processes in bacteria such as conjugation, transformation and transduction have been utilized under controlled conditions to produce desirable/valuable traits.

1801041454   Phycology, 3 CH (2+3), Prerequisite: 1801041102

This course introduces the ecological and economic significance of algae. The underlying principles of algal growth and their response to light, temperature, and nutrients are examined. The potential of algae to provide raw material for the biotechnological industry is reviewed. In addition, the harmful effects of algae and means of mitigation, algae for biofuel, microalgae for food, use of algae in nanotechnology and high value products from algae are discussed.

1801042468   Cytogenetics, 3 CH (2+3), Prerequisite: 1801042322

This course covers chromosome structure and function and studies the role of chromosomes in human disease. Topics that are covered include cytogenetic methodology, types of chromosome aberration, chromosomes and cancer, chromosome breakage syndromes and fragile sites on human chromosomes.

1801042477   Bioinformatics, 2 CH (1+3), Prerequisite: 110108112 and 1801042321 and 1801042322

This course is intended to provide the principles and applications of bioinformatics for students who have a biological background. In particular, students are introduced to integrated systems where a variety of data sources are connected through World Wide Web access.

1801041491   Seminar, 1 CH (1+0), Prerequisite: passing 90 hours or more

This course provides a forum for students to discuss a research article in one of the various fields of Biology or Biotechnology. Students choose an

in-depth research topic of their choice, present and discuss it with other students under the supervision of a faculty member.

1801042495 Special topics, 3 CH (3+0) Prerequisites: Student has finished 90 credit hours or more

This course studies a new topic in biology or biotechnology that is prepared by a faculty member and subjected to the department approval.

1801042496 Field Training, 3 CH, Prerequisite: passing 75 hours or more.

VI.V. Department of Allied Basic Sciences
VI.V.I. Introduction

The Department of Basic Sciences was established and combined to the Faculty of Science in the academic year 2010/2011. The department provides students with basic skills related to various fields they study in coming semesters. This helps raise the academic levels of students to high international standards and enables them to achieve their goals and ambitions.

At present, the department has a staff of (12) faculty members, in addition to members from other faculties. The faculty members are specialized, highly qualified and well experienced in using modern methods in teaching. The department offers 21 courses, some of which are prerequisites and others are free elective courses. Members that teach these courses are from different faculties including Faculty of Science, Nursing, Applied Health Sciences, Pharmaceutical Sciences, Natural Resources and Environment, Physical Education and Sport Science, Engineering and Faculty of Prince Al-Hussein Bin Abdallah II for Information Technology.

VI.V.II. Courses offered by the department

Course No.	Course Title	Weekly Contact Hours		Credit Hours	Prerequisite
		Lecture	Practical		
110108099	Computer Skills/ Prerequisite*	3	0	3	-
110108101	Calculus (1)	3	0	3	-
110108102	Principles of Mathematics	3	0	3	-
110108103	Principles of Statistics	3	0	3	-
110108104	Energy and its Sources	3	0	3	-
110108105	General Biology (1)	3	0	3	-
110108112	Computer Programming	3	0	3	110108099**
110108113	Biotechnology and Society	3	0	3	-
110108116	Computer Skills	3	0	3	110108099**
110108114	Automobile Essentials	3	0	3	-
110108115	Computer Ethics	3	0	3	-
110108130	Health and Nutrients	3	0	3	-

110108131	Health Education and First Aid	3	0	3	-
110108132	Sport and Health	3	0	3	-
110108133	Environmental Awareness	3	0	3	-
140108134	Ethics of Science	3	0	3	-
140108166	Medication Education	3	0	3	-
170108135	Reproductive Health	3	0	3	-
1701081136	General Physics (1)	3	0	3	-
1701081137	Basics of General Chemistry	3	0	3	-
1701081138	General Chemistry (1)	3	0	3	-

* This course should be taken if the student fails the "1001096" exam
** "Computer Skills/Prerequisite" course is a prerequisite for "Computer Skills" and "Computer Programming" courses only for students that take the course.

VI.V.III. Course descriptions

(110108099) Computer Skills/ Prerequisite: 3 CH (3+0) (no prerequisite)

This course is a general introduction to computer and computer system, its elements and their functions and computer applications. It introduces students to the ideal way of using computers and exploring software applications. In addition, it explains the hardware components and their functions, and in more details covers the system software and its application. Furthermore, the course addresses the basic concepts of internet and provided services. The practical part covers basic concepts in Windows and Microsoft office applications.

(110108101) Calculus (1): 3 CH (3+0) (no prerequisite)

This course introduces students to functions, limits and continuity, derivative and their applications, definite and indefinite integrals, applications of integral and transcendental functions.

(110108102) Principles of Mathematics: 3 CH (3+0) (no prerequisite)

This course familiarizes students with equations including linear, quadratic and cubic and with functions like linear, polynomials, rational, exponential, logarithmic and several variables. It also describes derivatives, differentiation techniques, integration and integral applications. Finally, the course elucidates the fundamentals of matrices such as algebra of matrices, solution of linear equation systems, determinants and Cramer rule for solving linear equation systems.

(110108103) Principles of Statistics: 3 CH (3+0) (no prerequisite)

This course is an introduction to descriptive measures, correlation and regression, probability, statistical inference and index numbers.

(110108104)   Energy and its Sources: 3 CH (3+0) (no prerequisite)

This course covers the energy concepts including renewable energy and unrenewable energy, energy transformation, solar cells and solar energy, energy storage, efficiency of energy sources, sources of alternative energy and obstacles facing its use, energy cost, and energy and environment.

(110108105)   General Biology (1): 3 CH (3+0) (no prerequisite)

This course covers the study of the basic principles of biology such as carbon-containing molecules, biological molecules, cell structure, cell membranes, cell respiration and cell division. It also describes the basic information of DNA structure, replication and gene expression.

(110108112)   Computer Programming: 3 CH (3+0), prerequisite: 110108099

This course introduces students to programming using the C++ Language. The course covers the fundamental concepts of analyzing problem statements, designing computer solutions as well as an introduction to the syntax and semantics of the C++ language. It also focuses on data types, variables, constants, operators and expressions, control flows, functions and arrays.

(110108113)   Biotechnology and Society: 3 CH (3+0) (no prerequisite)

This course covers the definition of biotechnology, the role of biotechnology in medicine, environment, agriculture, and industry with actual cases of biotechnology impacts on society.

(110108116)   Computer Skills: 3 CH (3+0), prerequisite: 110108099

This Course is designed to give students an introduction in Microsoft Office applications. This course also presents advanced topics in excel, access and front page. The practical part of the course is given for students in a lab.

(110108114)   Automobile Essentials: 3 CH (3+0) (no prerequisite)

This course introduces the students to fundamentals of engine systems (Ignition, fuel, lubrication and cooling), car systems (Power terrain, brakes, steering, suspension, air-conditioning and heating), exhaust and emission, wheels and tires, common malfunctions and remedies and automobile up-to-date technologies.

(110108115)   Computer Ethics: 3 CH (3+0) (no prerequisite)

The course covers the ethical issues that arise as a result of increasing use of computers. They include moral and professional issues such as cyberethics, intellectual property, privacy and anonymity, software piracy and plagiarism, hacking and hackers, viruses, liability, professional responsibility and globalization, computer crimes, computers in the

workplace, common computer ethics fallacies, ethics codes of conduct and resources and code of fair information practices.

(110108130)   Health and Nutrients: 3 CH (3+0) (no prerequisite)

The course covers the basics of health components, essential nutrients, food groups, planning a healthy diet, nutrients need throughout the life cycle, nutrition facts and role of nutrition in prevention and treatment of the most prevalent diseases such as obesity, diabetes and hypertension.

(110108131)   Health Education and First Aid: 3CH (3+0) (no prerequisite)

This course aims to acquaint students with the concept of health education and the relationship of culture to health. Because of its significant impact in raising the efficiency in individual health, psychologically and socially and impact on society, the course highlights the historical development of concepts of health and disease and how to maintain health through behaviors, nutrition and environment. It also focuses on behavioral variation and its impact, positively or negatively on health, especially the health of youth in the Jordanian society. Moreover, the course aims to acquaint students with basic principles of first aid and to deal with different emergencies, using methods of problem solving and creative thinking.

(110108132)   Sport and Health: 3CH (3+0) (no prerequisite)

This course addresses issues related to sport and health such as main concepts and general guidelines related to health and how to implement physical activity regimen in daily lifestyle. This course also highlights the principles of physical fitness, vascular system, physical activity and diseases such as cardiovascular diseases (e.g. high blood pressure and heart problems), cancer, diabetes, obesity, low back pain, osteoporosis, arthritis, and stress. Other issues related to sport and health like nutrition, sport injuries, posture, smoking, doping, sport and woman, sport and health in Islam will be also discussed

(110108133)   Environmental Awareness: 3 CH (3+0) (no prerequisite)

Facing environmental challenges has become an important unifier among scholars and decision makers because of their health impacts on the humankind. Therefore, this course aims at introducing students to various environmental problems, their negative impacts and affective preventive and mitigation measures including environmental regulations, signing regional and international environmental treaties and protocols that lead to sustainable use of natural resources particularly in energy and metallurgy sectors.

(140108134)   Ethics of Science: 3 CH (3+0) (no prerequisite)

In accordance with new developments in the field of higher education and standards and recommendations which emphasizes the importance of inclusion of the "Ethics of Science" course in the teaching curricula, this

course provides students with an introduction about ethics of science and the relationship between ethics and science. The course presents an entry to the basic concepts related to ethics and sciences as well as its linkages with values, habits and the laws. It also enhances the students' understanding of basic ethical theories in a simple manner that gives the students critical thinking in different scientific issues linked to ethics through the application of moral principles and standards in practicing sciences. Moreover, students study ethical issues associated with scientific research in different sciences. The course also discusses the relationship between sciences and human rights, the societal responsibilities implicated by practicing of sciences and the relationship between science and society. In addition, it presents the main ethical principles and issues associated with medical, human, literal, biological and industrial sciences.

(140108166)   Medical Education: 3 CH (3+0) (no prerequisite)

This course aims to raise the awareness of students about proper use of common medicines, cosmetics and herbal preparation. Their risks, benefits, use and misuse will be discussed as well as common ailments treatment and follow up. Moreover, the course provides the students with basic information about how to read the attached leaflet with medicine and proper storage ways.

(170108135)   Reproductive Health: 3 CH (3+0) (no prerequisite)

This course provides students with an introduction about reproductive health issues and their importance in raising the level of reproductive health, which has a significant impact on improving the health, psychological, social and economic level of the individual and society. The course also explains adolescent and youth health, women's and men's health, pre-marital care, maternity care, child growth and development, family planning issues, communicable diseases, reproductive cancers and how to prevent infection. Furthermore, it focuses on clarifying the impact of the behavior of individuals on their reproductive health, especially for youth.

(1701081136) General Physics (1): 3 CH (3+0) (no prerequisite)

This course provides students with basics of vectors and scalars, kinematics and dynamics of motion of particles, work and energy, conservation of energy, momentum, impulse, conservation of linear momentum, kinematics and dynamics of rotational motion, equilibrium of rigid bodies, harmonic motion, fluid mechanics and heat.

(1701081137) Basics of General Chemistry: 3 CH (3+0) (no prerequisite)

This course is intended to illustrate the basic principles of modern chemistry. It includes the following topics: the mole concept and chemical calculations, gases and gas laws, states of matter and intermolecular forces, properties of solutions, thermochemistry and chemical thermodynamics, chemical equilibrium in gaseous systems, acid–base

equilibria in aqueous solutions, electrochemistry and principles of organic chemistry.

(1701081138) General Chemistry (1): 3 CH (3+0) (no prerequisite)

The course is intended to illustrate the basic principles of modern chemistry. It includes the following topics: Atomic and molecular weights and stoichiometry, the mole concept, the atomic properties based on electronic structures, different types of chemical bonding's and molecular shapes, acids and bases, balancing chemical equations, metathesis reactions, gas laws and properties of gases and their reactions.