

# Faculty of Science

## Department of Mathematics

### Study Plan for the Bachelor Degree in Mathematics

**For the academic year  
2019/2020**

### **Vision:**

Excel in learning and teaching basic sciences, in conducting research and in serving the community.

### **Mission:**

Produce graduates who are academically capable and are skilled in the basic sciences by providing a stimulating scientific and research environment to keep up with the job market requirements.

### **Program Outcomes:**

1. Provide students with the knowledge of the foundations of mathematics
2. Provide students with knowledge in the various fields of mathematics
3. Develop the students logical thinking and enable them to build mathematical proofs
4. Give the students essential technological skills
5. Enable the students to use software to solve mathematical problems

### **Intended Learning Outcomes (ILOs):**

#### **Student will be able to:**

1. Applying knowledge and acquired mathematical skills in their discipline, in related sciences and in industry
2. Solving mathematical problems using modern technology
3. Analyzing data using statistical methods
4. Expressing mathematical thoughts and logic in writing mathematical proofs
5. Applying modern educational methods
6. Applying research methodology and critical thinking in various mathematical fields
7. Working independently and within teams
8. Assuming responsibility in various circumstances
9. Adhering to work ethics and moral standards

## Framework for Chemistry Bachelor Degree (135 Cr. Hrs.)

Classification	Credit Hours			Percentage
	Compulsory	Elective	Total	
University Requirements	12	12	24	17.78 %
Faculty Requirements	21	0	21	15.56 %
Program Requirements	75	12	87	64.44 %
Support Courses	0	0	0	00.00 %
Free Electives	0	3	3	2.22 %
<b>Total</b>	<b>120</b>	<b>90</b>	<b>135</b>	<b>100 %</b>

### Course Numbering: Example (Calculus 1)

1	1	0	1	1	1	0	1	
Faculty Code		Dept. Code		Course Level		Knowledge Field		Sequence

### Knowledge Areas

Number	Knowledge Field	Cr. Hr.
0	Calculus	12
1	Foundation of Mathematics	6
2	Algebra	12
3	Geometry and Topology	9
4	Statistics & Probability	12
5	Mathematical Analysis	12
6	Applied Mathematics	27
7	History of Mathematics	3
8	Training/Graduation project	3

## 1. University Requirements: (24 Credit Hours)

### 1.1. Compulsory University Requirements: (12 Credit Hours)

Course No.	Course Title	Hrs	Prerequisite	Co-requisite
01101101	Military Sciences *	3	Jordanian student	
01101102	Arabic Language *	3	Jordanian student	
01101111	English Language **	3	01100011	
01101112	National Education **	3	01100012	
<b>Total</b>		<b>12</b>		

\*Non-Jordanian student has the right to register it or choose one of the courses offered by the university.

\*\* If the student does not pass the level exams should be take the following courses:

Remedial Arabic language (01100011), Remedial English language (01100012), Remedial computer skills (0110005)

### 1.2. Elective: 15 Credit Hours from the following courses.

Course No.	Course Title	Hrs	Prerequisite	Co-requisite
01101103	Traffic Education	3	-	
01101104	Innovation and Entrepreneurship	3	-	
01101121	Life Skills	3	-	
01101131	Islamic Education	3	-	
01101132	Jerusalem and the Hashemite custodianship	3	-	
01101141	Sports and Health	3	-	
01101142	Environment and Society	3	-	
01101151	Computer Skills	3	01100051Pre	
01101152	Internet and communication	3		
01101161	Economics System and Concepts	3	-	
01101171	Psychology and Society	3		
01101172	Modern language	3		
01101213	Communication Skills in Arabic	3	01101111 Pre	
01101214	Communication Skills in English	3	01101112 Pre	
01101243	Safety and First Aid	3		
01101281	Scientific Research Methods	3	-	
01101282	Introduction to Astronomy	3		
03011101	Law in Our Life	3	-	
03021201	Human Rights	3	-	

## 2. Faculty Requirements: (21Credit Hours)

### 2.1 Compulsory Faculty Requirements: (21 Credit Hours)

Course No.	Course Title	Hrs	Theory	Prerequisite	Co-requisite
06051211	Programming Fundamentals	3	3	01100051	
11011101	General Chemistry (1)	3	3	-	
11011281	General Biology	3	3	-	
11021101	General Physics (1)	3	3	-	
11031101	Calculus (1)	3	3	-	
11031141	Statistics and Probabilities	3	3	11031101	
11031202	Calculus (2)	3	3	11031101	
<b>Total</b>		<b>21</b>	<b>21</b>		

### 2.2 Faculty Requirements Electives: (0 Credit Hours)

### 3. Department Requirements (87 Credit Hours)

#### 3.1. Compulsory Department Requirements: (75 Credit Hours)

Course No.	Course Title	Hrs	Theory	Prerequisites
11031211	Foundations of mathematics	3	3	
11031221	Linear algebra (1)	3	3	11031101
11032103	Calculus (3)	3	3	11031202
11032212	Number theory	3	3	11031211
11032164	Ordinary differential equations	3	3	11031202
11032242	Probability theory	3	3	11032103 11031141
11032222	Linear algebra (2)	3	3	11031221
11032261	Numerical analysis (1)	3	3	11031101 06051211
11032131	Euclidean and non-Euclidean geometry	3	3	-
11033104	Advanced calculus	3	3	11032103
11033265	Partial differential equations	3	3	11032164
11032251	Real analysis (1)	3	3	11031211 11031202
11033152	Complex analysis	3	3	11032103 11032251
11033162	Numerical analysis (2)	3	3	11032261
11033243	Mathematical statistics	3	3	11032242
11034123	Abstract algebra (1)	3	3	11032212
11033232	General Topology (1)	3	3	11031211
11033166	Linear programming and applications	3	3	11032222
11034163	Mathematical modeling	3	3	06051211
11033253	Real analysis (2)	3	3	11032251
11034224	Abstract algebra (2)	3	3	11034123
11034144	Applied statistics	3	3	11033243
11034167	Applied mathematics	3	3	11033265
08014162	Mathematics curricula and teaching methods	3	3	4 <sup>th</sup> level
11034291	Graduation project	3	3	Department approval
<b>Total</b>		<b>75</b>	<b>75</b>	

### 3.2 Department Electives: (12Credit Hours)

Course No.	Course Title	Hrs	Theory	Practical	Prerequisites
11033269	Special topics in mathematics	3	3	-	4 <sup>th</sup> level
11033225	Matrix theory	3	3	-	11031221
11033254	Special functions	3	3	-	11032164
11034171	History of mathematics	3	3	-	4 <sup>th</sup> level
11033168	Graph theory	3	3	-	11031211
11034233	General Topology (2)	3	3	-	11033232
11034155	Functional analysis	3	3	-	11033253

### 4. Support Courses (0 Credit Hours)

### 5. Free Electives: 3 Credit Hours

Course No.	Course Title	Hrs	Prerequisite	Corequisite
	<b>Total</b>	<b>3</b>		

## Study Plan Guide for the Bachelor Degree in Mathematics

First year				
First semester				
Course No.	Course Title	Hrs	Prerequisites	Co-requisites
11031101	Calculus (1)	3	-	
11031141	Statistics and probability	3	-	
01101111	Arabic language	3	01100011	
01101112	English language	3	01100012	
06051211	Programming Fundamentals	3	01100051	
-	University optional requirement	3		
<b>Total</b>		<b>18</b>		
Second semester				
Course No.	Course Title	Hrs	Prerequisites	Co-requisites
12011181	General biology	3	-	
11031221	Linear algebra (1)	3	11031101	
11031211	Foundations of mathematics	3	-	
11031202	Calculus (2)	3	11031101	
01101102	National education	3	-	
-	University optional requirement	3		
<b>Total</b>		<b>18</b>		



**Second year**

**First semester**

Course No.	Course Title	Hrs	Prerequisites	Co-requisites
11032131	Euclidean and non-Euclidean geometry	3	-	
11032103	Calculus (3)	3	11031202	
11011101	General Chemistry (1)	3	-	
11032164	Ordinary differential equations	3	11031202	
11021101	General physics (1)	3	-	
-	University optional requirement	3		
<b>Total</b>		<b>18</b>		

**Second semester**

Course No.	Course Title	Hrs	Prerequisites	Co-requisites
11032222	Linear algebra (2)	3	11031221	
11032242	Probability theory	3	11032103 11031141	
11032261	Numerical analysis (1)	3	06051211 11031101	
11032251	Real analysis (1)	3	11031211 11031202	
-	Department optional requirement	3		
<b>Total</b>		<b>18</b>		

Third year				
First semester				
Course No.	Course Title	Hrs	Prerequisites	Co-requisites
11033104	Advanced Calculus	3	11032103	
11033162	Numerical analysis (2)	3	11032261	
	University optional requirement	3		
11033166	Linear programming and applications	3	11032222	
11033152	Complex analysis	3	11032251 11032103	
-	Department optional requirement	3		
<b>Total</b>		<b>18</b>		
Second semester				
Course No.	Course Title	Hrs	Prerequisites	Co-requisites
11033253	Real analysis (2)	3	11032251	
11033265	Partial differential equations	3	11032164	
11033232	General Topology (1)	3	11031211	
11033243	Mathematical statistics	3	11032242	
-	Department optional requirement	3		
<b>Total</b>		<b>15</b>		

Fourth year				
First semester				
Course No.	Course Title	Hrs	Prerequisites	Co-requisites
11034163	Mathematical modeling	3	06051211	
11034167	Applied mathematics	3	11033265	
11034123	Abstract algebra (1)	3	11032212	
11034144	Applied statistics	3	11033243	
-	Department optional requirement	3		
<b>Total</b>		<b>15</b>		
Second semester				
Course No.	Course Title	Hrs	Prerequisites	Co-requisites
08014162	Mathematics curricula & teaching methods	3	4 <sup>th</sup> level	
11034224	Abstract algebra (2)	3	11034123	
01101101	Military sciences	3	-	
-	Free course	3		
	Optional department requirement	3		
<b>Total</b>		<b>15</b>		

## Description of Courses offered by the Department of Mathematics

<b>11031101</b>	<b>Calculus (1)</b>	<b>3 Credit Hours</b>	<b>Prerequisite:- No</b>
Functions, transformations, trigonometric functions, their limits, squeeze theorem, continuity, differentiation, its definition, chain rule, implicit differentiation, extrema and critical points, concavity and inflection points, sketching functions, integration, indefinite and definite integration, integration by substitution.			
<b>11031102</b>	<b>Calculus (2)</b>	<b>3 Credit Hours</b>	<b>11031101 Pre</b>
Inverse functions; exponential, logarithmic, trigonometric, inverse trigonometric, hyperbolic and inverse hyperbolic functions; their derivatives and integrals, integration methods, improper integrals, applications of integration (areas, volumes, curves lengths and surface areas); introduction to sequences and series.			
<b>11031141</b>	<b>Statistics and probability</b>	<b>3 Credit Hours</b>	<b>11031101 Pre</b>
Introduction to statistics, populations and samples, frequency distributions; measures of centrality, dispersion, skewness and kurtosis; correlation & regression; principles of probability, laws of addition and multiplication, total probability rule, Bayes rule, random variables, discrete and continuous probability distributions, binomial distribution, poisson distribution.			
<b>11031211</b>	<b>Foundations of mathematics</b>	<b>3 Credit Hours</b>	<b>Prerequisite:- No</b>
Logic: axioms, theorems, negation, $\neg$ ; set algebra: union, intersection, symmetric difference, difference, complement; functions: domain, range, one-to-one functions, onto functions, graphs, set relations: equivalence relations & classes, partial ordering relation, total order, number of elements of a set, finite sets, countable sets, uncountable sets.			
<b>11031221</b>	<b>Linear Algebra (1)</b>	<b>3 Credit Hours</b>	<b>11031101 Pre</b>
System of linear equations, matrices, matrix algebra, homogeneous and nonhomogeneous systems, Gaussian elimination, elementary matrices, inverse matrix calculation, determinants, Euclidean vector space, linear transformations from $R^n$ to $R^m$ and properties, general vector space, vector subspace, base, dimension, matrix row space, column space & null space; matrix rank, inner product space, eigenvalues and eigenvectors, matrix diagonalization			
<b>11032103</b>	<b>Calculus (3)</b>	<b>3 Credit Hours</b>	<b>11031102 Pre</b>
3 dimensional space, vectors, lines and planes, functions of several variables, partial derivatives and applications, multiple integrals and applications			

<b>11032212</b>	<b>Number theory</b>	<b>3 Credit Hours</b>	<b>11031211 Pre</b>
Division algorithm, divisibility, greatest common factor, least common multiple, Diophantine equations, prime numbers and their distribution, fundamental theorem of arithmetic, congruence relations, linear congruence equations, Chinese remainder theorem, divisibility tests, Fermat's little theorem, Wilson's theorem, arithmetic functions, cryptography.			
<b>11032164</b>	<b>Ordinary differential equations</b>	<b>3 Credit Hours</b>	<b>11031102 Pre</b>
Classification, solving 1 <sup>st</sup> order, 2 <sup>nd</sup> order and higher order equations, applications in mechanics and physics, Laplace method, power series solution, regular and irregular singular points, linear and nonlinear equations, homogeneous and nonhomogeneous equations			
<b>11032242</b>	<b>Probability theory</b>	<b>3 Credit Hours</b>	<b>11032103 Pre</b> <b>11031141 Pre</b>
Introduction, samples space, events, probability of an event, probability laws, conditional probability, independent events, Bayes Theorem, probability distribution, discrete and continuous random variables, probability density function, multivariate distributions, marginal distribution, joint distribution, expected value, moments, moment generating function, uniform discrete distribution, binomial distribution, Poisson distribution, normal distribution, functions of random variables			
<b>11032222</b>	<b>Linear algebra (2)</b>	<b>3 Credit Hours</b>	<b>11031221 Pre</b>
General vector space, row space, column space, null space, rank and nullity, change of basis, eigenvalues and eigenvectors, similar matrices and diagonalization, orthogonal diagonal matrices, The diagonalization of symmetric matrices, general linear transformations, kernel and range, inverse linear transformations, matrices of general linear transformations, quadratic forms, diagonalization of quadratic forms, classification of quadratic forms, curves and surfaces.			
<b>11032261</b>	<b>Numerical analysis (1)</b>	<b>3 Credit Hours</b>	<b>11031101 Pre</b> <b>11031211 Pre</b>
Introduction to computational errors and their sources, solutions of nonlinear equations, interpolation theory, curve fitting and differences, function approximation, solution of linear systems by direct and indirect methods			
<b>11032131</b>	<b>Euclidean and non-Euclidean geometry</b>	<b>3 Credit Hours</b>	<b>None</b>
Axiomatic systems: consistency, independence and completeness, finite projective geometry, paradoxes of Euclidean geometry, the postulates of connection, distance, angles and angle measurement, congruence postulate, parallel postulate, plane-separation postulate, space-separation theorem, Pasch theorem, similarity, Pythagorean theorem, theorems of Ceva and Menelous, Erdős theorem, circles, circle theorems, cyclic quadrilaterals, Simson line, nine point circle, lines and planes in space			

**11033104 Advanced Calculus 3 Credit Hours 11032103 Pre**

Directional derivative, gradient, divergence, curl, curvilinear coordinates, vector integral calculus, path integral, surface integral, volume integral, Green's theorem, Stoke's theorem, divergence theorem, implicit function theorem, inverse function theorem.

**11033265 Partial differential equations 3 Credit Hours 11032164 Pre**

Classification, models in physics, heat equation, wave equation, Laplace equation, separation of variables, Sturm-Louisville BVP, Fourier series and integration, Fourier transformation, homogeneous and nonhomogeneous problems, infinite domain problems, BVP on rectangular and circular domains, special functions, Bessel and Legendre functions, BVP on cylindrical and spherical domains.

**11032251 Real analysis (1) 3 Credit Hours 11031102 Pre 11031211 Pre**

The completeness property of  $\mathbb{R}$ . The Archimedes principle in  $\mathbb{R}$ ; limit of a sequence, Cauchy sequences, convergent sequences, monotone sequences, subsequences and limit points, Bolzano--Weierstrass theorem, open sets, bounded sets and compact sets in  $\mathbb{R}$ . Limits of real valued functions, sequence definition and neighborhood definition of continuity, boundedness of continuous functions on compact intervals, the extreme value theorem, the intermediate value theorem. uniformly continuous functions, the sequential criterion for uniform continuity, the derivative of functions, Rolle's theorem, the mean value theorem. generalized mean value theorem. Taylor's theorem with remainder, l' Hospital's rule.

**11033152 Complex analysis 3 Credit Hours 11032103 Pre 11032251 Pre**

The structure of complex numbers, definition, geometric meaning, polar form, Euler's formula, powers and roots of complex numbers, complex plane, complex functions, examples, limits, continuity, derivatives, Cauchy-Reimann equations, analytic functions, definition and properties. Harmonic functions (definition and basic properties). Elementary complex valued functions (exponential, trigonometric, hyperbolic, and logarithmic functions: their definitions and basic properties and inverse functions). Branches of logarithmic functions. Contours and contour integration. The Cauchy-Goursat theorem. Simply and multiply connected regions. The Cauchy integral formula.

**11033162 Numerical analysis (2) 3 Credit Hours 11032261 Pre**

Numerical integration and differentiation, methods to solve ordinary and partial differential equations, numerical methods to find eigenvalues.

**11033243 Mathematical statistics 3 Credit Hours 11032242 Pre**

The uniform, gamma exponential, chi-square and beta distributions, the normal approximation to the binomial distribution, distribution function technique, transformation technique (one variable, two variable), moment-generating function technique, the distribution of the mean: finite populations, the t-distribution, the F-distribution, point estimate, unbiased estimate, consistent estimate, sufficient estimate, the method of moments, the method of maximum likelihood, confidence intervals for: means, difference between means, proportions, difference between proportions, variance, ratio of variances, testing of statistical hypothesis, tests concerning means; differences between means, variances, proportions.

**11034123 Abstract algebra (1) 3 Credit Hours 11032212 Pre**

Groups and subgroups, cyclic groups, permutation groups, isomorphism's of groups, direct product of groups, cosets and Lagrange's theorem, normal subgroups and factor groups, homomorphisms of groups, the first isomorphism theorem, rings, subrings, integral domain, factor ring, and ideals.

**11033232 General Topology (1) 3 Credit Hours 11031211 Pre**

Topological spaces; open sets; boundary; interior; accumulation points; topologies induced by functions; subspace topology; bases and subbases; finite products; continuous functions; open and closed functions, homeomorphisms; separation axioms, countability axioms; metric spaces, connectedness and continuity.

**11033166 Linear programming and applications 3 Credit Hours 11032222 Pre**

Foundations of linear programming, the simplex method, the geometry of the simplex method, duality in linear programming, the dual simplex method, sensitivity analysis, introduction to graphs, networks and network flows.

**11034163 Mathematical modeling 3 Credit Hours 11032222 Pre**

MATLAB software, frontend, variables, data types, single and multidimensional matrices, programming scripts, functions,  $\_$ , curves, 2d and 3d plots, conditional statements, loop statements, advanced topics in MATLAB.

**11033253 Real analysis (2) 3 Credit Hours 11032251 Pre**

Functions of bounded variation, total variation, Riemann integral, definition, existence, basic properties, types of Riemann integrable functions (step functions, continuous functions, monotone functions), the mean value theorems for Riemann integral, the fundamental theorem of calculus, the Riemann-Stieltjes integral, definition, basic properties, integration by parts, integrability of continuous functions and monotone functions, the fundamental theorem for Riemann-Stieltjes integral, the mean value theorem, linear transformations on  $\mathbb{R}^n$  and their matrix representation (fast revision), functions from  $\mathbb{R}^n$  to  $\mathbb{R}^m$  (basic setup and examples), derivatives of vector valued functions of several variables, directional derivatives, point and uniform limits of functions sequences and series, power series

**11034224 Abstract algebra (2) 3 Credit Hours 11034123 Pre**

Rings, subrings, integral domains, factor rings and ideals, ring homomorphisms, polynomial rings; factorization of polynomials, reducibility and irreducibility tests, divisibility in integral domains, principal ideal domains and unique factorization domains

**11034144 Applied statistics 3 Credit Hours 11033243 Pre**

sampling distribution, chi-square tests, variation analysis, linear regression, nonparametric tests

**11034167 Applied Mathematics 3 Credit Hours 11033265 Pre**

Ordinary differential equations review (first order ODEs and higher order ODEs, methods of solution), boundary value problems (Sturm- Liouville Problem), solution of differential equations using power series, Frobenius method, Fourier series, Fourier coefficients, convergence of Fourier series, applications, Fourier sine and cosine series , Fourier integrals, solutions of vibrating string equation, Laplace equation and the heat equation using Fourier series

**11034291 Graduation project 3 Credit Hours Department approval**

The student writes and discuss a research on a topic determined by the supervisor that provides a solution to a real problem, or a service to the community. It is not necessary that the research idea be new.

**11033225 Matrix theory 3 Credit Hours 11031221 Pre**

Kronecker product of matrices, matrix functions, matrix equations, matrix differential equations, eigenvalues and eigenvectors, the characteristic polynomial, the minimal polynomial, Cayley-Hamilton theorem, canonical forms, Gershgorin's discs, strictly diagonally dominant matrices, Hermitian and unitary matrices, Schur's triangularization theorem, spectral theorem for normal matrices, positive semidefinite matrices, quadratic forms, polar decomposition and singular value decomposition, Moore-Penrose generalized inverse; matrix norms, QR factorization

**11033254 Special functions 3 Credit Hours 11032164 Pre**

Frobenius method, Frobenius and Laplace transformations, gamma function, beta function, relationship between gamma and beta functions, Bessel function; Legendre, Hermite, Laguerre, Jacobi and Chebychev Polynomials

**11034171 History of mathematics 3 Credit Hours 4<sup>th</sup> level**

Evolution of some mathematical concepts, facts and algorithms in arithmetic, algebra, trigonometry, Euclidean geometry, analytic geometry and calculus through the early civilizations of Egyptians, Babylonians, Greeks, Indians, Chinese, Muslims and Europeans; evolution of solutions of some conjectures and open problems.



**11033168 Graph theory 3 Credit Hours 11031211 Pre**

Counting methods ( inclusion-exclusion principle, recurrence relations) basic concepts in graph theory, vertices, edges, vertex degree,  $\chi$ , directed graphs, undirected graphs, complete graphs, paths, cycles, connected graphs, Euler's and Hamilton's paths, matrix representation of graphs, trees, graph coloring, shortest path algorithm, maximum flow algorithm

**11034233 General Topology (2) 3 Credit Hours 11033232 Pre**

Separation axioms T2, T3, T4 and some examples and theorems related to them, compact spaces and some related theorems, connected spaces and some related theorems, metric spaces and some related examples and theorems, sequences and their convergence in topological spaces

**11034155 Functional analysis 3 Credit Hours 11033253 Pre**

Norms on vector spaces, examples of norms, relationship between norms and metrics on vector spaces, sequences in normed spaces, convergence of sequences in normed spaces (strong convergence), complete normed spaces, examples of complete normed spaces, finite dimensional normed spaces, Banach spaces, Hilbert spaces, compactness, Hahn-Banach theorem, finite dimensional normed spaces, compactness of the unit ball in normed spaces, linear operators on Normed spaces. continuous linear operators, bounded linear operators, norms on bounded linear operators