

Study Plan of Bachelor's Degree

1.	School	Faculty of basic and marine Sciences
2.	Department	Department of Mathematics
3.	Program title (Arabic)	البكالوريوس في الرياضيات
4.	Program title (English)	B.Sc. In Mathematics

5. Degree Requirements:

The bachelor's degree in **Mathematics** consists of (132 credit hours):

Number	Type of requirement	Credit hours
1	University Requirements	27
2	Faculty Requirements	21
3	Specialization Requirements	84
Total		132

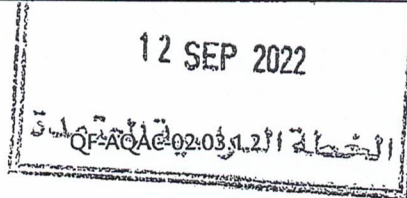
6. Numbering System:

A- Department number

Number	Department
01	Marine Biology
02	Coastal Environment
03	Biological Sciences
04	Mathematics

B- Course number consists of 7 digits

School	Department	Level	Serial number
5	01	4	1-4
			0-9
			1-9



C- Course number

Domain number	Domain title	Domain number	Domain title
0	Calculus and General Mathematics	5	Foundation of mathematics
1	Mathematical Analysis	6	Geometry and Topology
2	Differential Equations	7	Actuarial and Applied mathematics
3	Statistics and Probability	8	Teaching mathematics and History of Mathematics
4	Algebra	9	Seminar and Research

1. University Requirements (27 credit hours):

Compulsory Requirements(18 credit hours)					
No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Military Science	5151101	3		
2	National Culture	5152101	3		
3	Learning&Research Skills	5192100	3	5411099 5111099 5122099	
4	Communication Skills	5191002	3	5192100	
5	Introduction to Philosophy and Critical Thinking	5131103	3	5192100	
6	Ethics and human values	5151102	3		

Preparation Program Requirements(0 - 15 Credit Hours)

All students admitted to the university must apply for a degree examination in Arabic and English and the computer is prepared or approved by the university to determine their level. Based on the results of the examinations, either the student will study one or more of the requirements of the preparatory program

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Basics of Arabic	5122099	3		Pass/Fail
2	Arabic Languages Skills	5122103	3	5122099	Pass/Fail
3	Basics of English	5111099	3		Pass/Fail
4	English Language Skills	5111103	3	5111099	Pass/Fail
5	Basics of Computing skills	5411099	3		Pass/Fail

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Elective Courses
(9 Credit Hours)

Elective courses: (9) credit hours to be chosen from the first, second and third groups mentioned below. The student has to choose one course from each of the groups.

(First Group)

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Great Books	5110100	3		
2	Islam and Current Issues	5110099	3		
3	Arab-Islamic Civilization	5110101	3		
4	Jordan: History and Civilization	5310099	3		
5	Jerusalem	5310100	3		
6	Human Civilization	5103100	3		

Electives

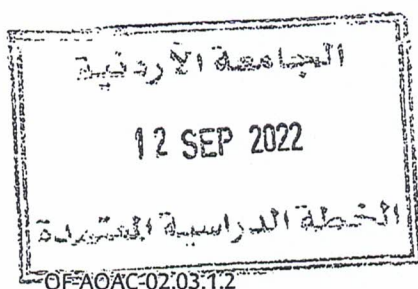
(Second Group)

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Legal Culture	5141100	3		
2	Environmental Culture	5510099	3		
3	Physical Fitness Culture	5110102	3		
4	Islamic Culture	5111100	3		
5	Health Culture	5510100	3		

Electives

(Third Group)

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Entrepreneurship & Creativity	5210099	3		
2	Foreign Language	5161100	3		
3	Electronic Commerce	5210100	3		
4	Social Media	5410099	3		
5	Appreciation of Arts	5143100	3		
6	Special Subject	5310101	3		



2. Obligatory School courses: (21 credit hours):

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
5504101	Calculus1	3	-	3	-
5504131	Principles of Statistics	3	-	3	-
5401201	Computer Skills for Scientific Faculties	3	-	3	5411099 or 5401098
5501101	General Biology (1)	3	-	3	-
5502101	General Chemistry (1)	3	-	3	-
5501103	General Physics (1)	3	-	3	-
5502221	Marine Sciences	3	-	3	-

3. Specialty courses: (84 credit hours):

A. Obligatory specialty courses: (75) credit hours

B. Elective specialty courses: (9) credit hours

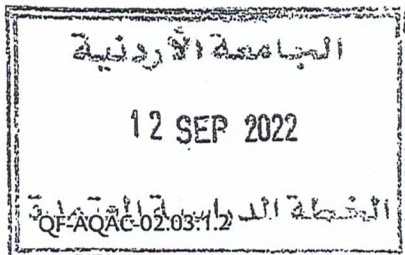
A. Obligatory specialty courses: (75 credit hours) includes:

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
5504102	Calculus (2)	3	-	3	5504101
5504201	Calculus (3)	3	-	3	5504102
5504211	Set Theory	3	-	3	5504102
5504212	Real Analysis (1)	3	-	3	5504211
5504221	Ordinary Differential Equations (1)	3	-	3	5504102
5504233	Probability Theory	3	-	3	5504201
5504241	Linear Algebra (1)	3	-	3	5504101
5504261	Euclidean Geometry	3	-	3	5504211
5504273	Mathematical Software Packages	3	-	3	5504221
5504301	Advanced Calculus	3	-	3	5504201
5504321	Partial Differential Equations	3	-	3	5504221
5504341	Abstract Algebra (1)	3	-	3	5504211
5504342	Number Theory	3	-	3	5504211
5504344	Linear Algebra (2)	3	-	3	5504241
5504371	Linear Programming	3	-	3	5504241
5504372	Numerical Analysis (1)	3	-	3	5504221

					+
					550273
5504374	Operations Research	3	-	3	5504233
5504375	Mathematical Modelling	3	-	3	5504221
5504411	Real Analysis (2)	3	-	3	5504212
5504412	Complex Analysis	3	-	3	5504212
5504421	Ordinary Differential Equations (2)	3	-	3	5504221
5504431	Mathematical Statistics	3	-	3	5504233
5504442	Abstract Algebra (2)	3	-	3	5504341
5504465	General Topology	3	-	3	5504212
5504481	Mathematical Education	3	-	3	5504341

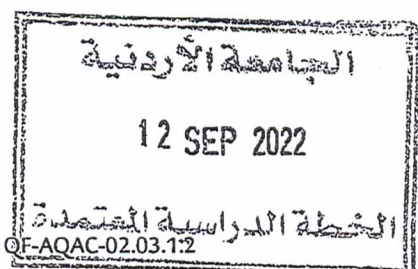
B. Elective specialty courses (9 credit hours). Student selects them from the list:

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
5504232	Statistical Techniques	3	-	3	5504131
5504275	Financial Mathematics	3	-	3	5504102
5504337	Sampling Theory and its Applications	3	-	3	5504131
5504352	Fuzzy Sets	3	-	3	5504211
5504415	Functional Analysis	3	-	3	5504411
5504424	Special Functions	3	-	3	5504301
5504445	Graph Theory	3	-	3	5504241
5504446	Cryptology	3	-	3	5504342
5504461	Non-Euclidean Geometry	3	-	3	5504261
5504472	Numerical Analysis (2)	3	-	3	5504372
5504482	History of Mathematics	3	-	3	5504301
5504491	Special Topics in Mathematics	3	-	3	5504212



Fourth: Courses offered by other faculties and departments

Course Number	Course Title	Contact Hours		Credit Hours	Pre-requisite
		Theoretical	Practical		
5401201	Computer Skills for scientific faculties	3	-	3	5411099 or 5401098
5501101	General biology (1)	3	-	3	-
5502101	General chemistry (1)	3	-	3	-
5501103	General physics (1)	3	-	3	-
5502221	Marine Sciences	3	-	3	-



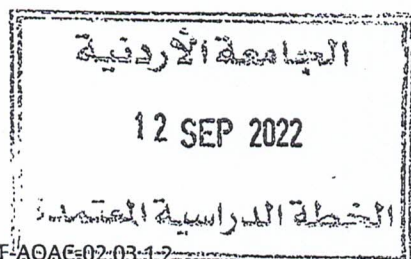
Fifth: Advisory Study Plan

First academic year:

(1 st) Semester			(2 nd) Semester		
Course Number	Course Title	Credit Hours	Course Number	Course Title	Credit Hours
5504101	Calculus (1)	3	5504102	Calculus (2)	3
5504131	Principles of Statistics	3	5504241	Linear Algebra (1)	3
5501103	General Physics (1)	3	5502101	General Chemistry (1)	3
	compulsory university requirement	3	5501101	General Biology (1)	3
	elective university requirement	3		compulsory university requirement	3
Total		15	Total		15

Second academic year:

(1 st) Semester			(2 nd) Semester		
Course Number	Course Title	Credit Hours	Course Number	Course Title	Credit Hours
5504201	Calculus (3)	3	5504233	Probability Theory	3
5504221	Ordinary Differential Equations (1)	3	5504261	Euclidean Geometry	3
5504211	Set Theory	3	5504273	Mathematical Software Packages	3
5502221	Marine Sciences	3	5504301	Advance Calculus	3
5401201	Computer Skills for Scientific Faculties	3	5504371	Linear Programming	3
	compulsory university requirement	3		elective university requirement	3
Total		18	Total		18



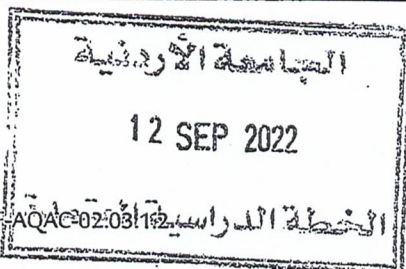
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Third academic year:

(1 st) Semester			(2 nd) Semester		
Course Number	Course Title	Credit Hours	Course Number	Course Title	Credit Hours
5504212	Real Analysis (1)	3	5504341	Abstract Algebra (1)	3
5504321	Partial Differential Equations	3	5504372	Numerical Analysis (1)	3
5504342	Number Theory	3	5504374	Operations Research (1)	3
5504344	Linear Algebra (2)	3	5504375	Mathematical Modelling	3
	elective speciality course	3	5504431	Mathematical Statistics	3
	compulsory university requirement	3		compulsory university requirement	3
Total		18	Total		18

Fourth academic year:

(1 st) Semester			(2 nd) Semester		
Course Number	Course Title	Credit Hours	Course Number	Course Title	Credit Hours
5504411	Real Analysis (2)	3	5504421	Ordinary Differential Equations (2)	3
5504412	Complex Analysis	3	5504442	Abstract Algebra (2)	3
5504465	General Topology	3	5504481	Mathematical Education	3
	compulsory university requirement	3		elective university requirement	3
	elective speciality course	3		elective speciality course	3
Total		15	Total		15



Sixth: Course Descriptions

5504101	Calculus (1) (3 credit hours)
	<p>Prerequisite: none</p> <p>The course aims to familiarize students with the main concepts in calculus and some applications in physics and engineering. The course covers the following topics: Functions: domain, operations on functions, graphs of functions; trigonometric functions; limits: meaning of a limit, computational techniques, limits at infinity, infinite limits; continuity; limits and continuity of trigonometric functions; the derivative: techniques of differentiation, derivatives of trigonometric functions; the chain rule; implicit differentiation; differentials; Roll's Theorem; the mean value theorem; the extended mean value theorem; L'Hopital's rule; increasing and decreasing functions; concavity; maximum and minimum values of a function; graphs of functions including rational functions (asymptotes) and functions with vertical tangents (cusps); antiderivatives; the indefinite integral; the definite integral; the fundamental theorem of calculus ; the area under a curve; the area between two curves; transcendental functions: inverse functions, logarithmic and exponential functions; derivatives and integrals; limits (the indeterminate forms); hyperbolic functions and their inverses; inverse trigonometric functions.</p>
5504102	Calculus (2) (3 credit hours)
	<p>Prerequisite: 5504101</p> <p>This course aims to introduce the student to the basic concepts of calculus, with an in-depth look at the methods of integration and its application. The course covers the following topics: Techniques of integration: integration by substitution; integration by parts, integrating powers of trigonometric functions, trigonometric substitutions, integrating rational functions, partial fractions, rationalization, miscellaneous substitution; improper integrals; application of definite integral: volumes, length of a plane curve, area of a surface of revolution polar coordinates and parametric equations: polar coordinates, graphs in polar coordinates, area in polar coordinates; infinite series: sequences, infinite series, convergence tests, absolute convergence, conditional convergence; alternating series; power series: Taylor and Maclurine series, differentiation and integration of power series.</p>
5504131	Principle of statistics (3 credit hours)
	<p>Prerequisite: none</p> <p>This course aims to introduce the student to the basic concepts of statistics and probability and some applications from real life problems. It covers the following topics: describing statistical data by tables, graphs and numerical measures, Chebychev's inequality and the empirical rule, counting methods, combinations, permutations, elements of probability and random variables, the binomial, the Poisson, and the normal distributions, sampling distributions, elements of testing hypotheses. Applied problems on testing hypothesis from engineering, medical, and educational sciences.</p>
5504201	Calculus (3) (3 credit hours)
	<p>Prerequisite: 5504102</p> <p>The course covers the following topics: three dimensional space and vectors rectangular coordinates in 3-space; spheres, cylindrical surfaces; quadric surfaces; vectors: dot</p>

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	product, projections, cross product, parametric equations of lines. planes in 3-spaces; vector -valued functions: calculus of vector valued functions, change of parameters, arc length, unit tangent and normal vectors, curvature, functions of two or more variable: domain, limits, and continuity; partial derivatives; differentiability; total differentials; the chain rule; the gradient; directional derivatives; tangent planes; normal lines; maxima and minima of functions of two variables; Lagrange multipliers; multiple integrals: double integral, double integrals and some applications, double integrals in polar coordinates; triple integrals; triple integrals in cylindrical and spherical coordinates; change of variables in multiple integrals. Evaluate volumes using triple integral based on spherical and cylindrical coordinates.
5504211	Set Theory (3 credit hours)
	Prerequisite: 5504102
	Logic: axioms and theorems, negations, quantifiers. Algebra of sets: union, intersection, symmetric difference, difference, complement. Functions: domain and range, different classes of functions including 1-1 and onto, graph of a function. Relations on sets: equivalence relations and equivalence classes, partial order relation, total order relation. Cardinality of sets: finite sets, countable sets, uncountable sets.
5504212	Real Analysis (1) (3 credit hours)
	Prerequisite: 5504211
	The completeness property of \mathbb{R} . The Archimedean principle in \mathbb{R} . Limit of a sequence. Convergent sequences. Monotone and bounded sequences. Cauchy sequences. Subsequence and limit points. Bolzano-Weierstrass Theorem. Open sets, closed sets, bounded sets and compact sets in \mathbb{R} . Limits of real valued functions. Definition of limits by neighbourhoods. Definition of limits by sequences. Continuous functions on \mathbb{R} . Sequence definition and neighbourhood 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 Mean value theorem. Generalized Mean value theorem. Taylor Theorem with remainder. L' Hospital's rule.
5504221	Ordinary Differential Equations (1) (3 credit hours)
	Prerequisite: 5504102
	Familiarize student with the definition of differential equations. Physical and engineering models include differential equations. Importance of differential equations in different fields such as sciences, engineering, industry, medical sciences as well as human and educational studies. Solutions of differential equations (first order, second order, and higher orders) with applications to mechanics and physics, series solutions, Laplace transform method. Applications (Newton's law of cooling, glucose absorption in the body, the spread of epidemics, ...).
5504232	Statistical techniques (3 credit hours)
	Prerequisite: 5504131
	Simple and multiple regression, correlation coefficient, the analysis of variance of one and two-factor experiments, the Latin squares, Chi square test for homogeneity, independences, and goodness of fit, nonparametric statistics: the sign test, Wilcoxon rank sum test, Wilcoxon signed rank test, and Mann-Whitney test, Spearman correlation coefficient.

5504233	Probability Theory (3 credit hours)
	Prerequisite: 5504201
	Distributions of random variables; conditional probability and stochastic independence; some special distributions (discrete and continuous distributions); univariate, bivariate and multivariate distributions; distributions of functions of random variables (distribution function method, moment generating function method, and the Jacobian transformation method); limiting distributions.
5504241	Linear Algebra (1) (3 credit hours)
	Prerequisite: 5504101
	Familiarize student with the definition of algebra. Importance of algebra and system of equations in sciences and engineering. Systems of linear equations; matrices and matrix operations; homogeneous and nonhomogeneous systems; elementary row operations, Gaussian elimination; elementary matrices and a method for finding inverse ; determinants; Euclidean vector spaces; linear transformations from R^n to R^m and their properties; general vector spaces; subspaces; basis; dimension; row space; column space; null space of a matrix; rank and nullity; inner product spaces; eigenvalues and diagonalization; linear transformations. Some important applications such as cryptology, game theory, computer science, artificial intelligence.
5504261	Euclidean Geometry (3 credit hours)
	Prerequisite: 5504211
	Axiomatic systems: consistency, independence and completeness, finite projective geometry, paradoxes of Euclidean geometry, the postulates of connection, the measurement of distance, ruler postulate, order relations, plane-separation postulate, space-separation theorem, Pasch theorem, further properties of angles, triangles, congruence postulate, parallel postulate, similarity, Pythagorean theorem, theorems of Ceva and Menelous, Erdős theorem, circles, central and inscribed angles, cyclic quadrilaterals, Simson's line, nine point circle, lines and planes in space.
5504273	Mathematical Software Packages (3 credit hours)
	Prerequisite: 5504221
	Mathematica or other software packages such as Maple or MATLAB, are used in a computer lab to illustrate selected mathematical concepts, explore some mathematical facts, build algorithms for problem solving cases, do numerical and analytical computations, do simulation studies and plot graphs. The selected topics can cover a wide range of mathematical topics such as geometry, calculus, linear algebra, linear programming, differential equations, probability, statistics, number theory, Fourier and Laplace transforms. The course starts with training on using the package and ends with writing Mathematica code to solve some specific mathematical problems.
5504275	Financial Mathematics
	Prerequisite: 5504102
	Familiarize student with the definition of financial mathematics and its importance in data analysis, problem solving and financial markets modelling. The course covers the following main topics: an introduction to mathematical and numerical models used to price financial securities and make risk estimates. Topics include time value of money, simple and compound interest, annuities, Amortization and Sinking Funds and Bonds. Common applications: risk management, Market risk, operational risk, liquidity risk, econometrics, forecasts, and investment strategies.

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5504301	Advanced Calculus (3 credit hours)
	Prerequisite: 5504201 Vector differential calculus: gradient, divergence, curl, curvilinear coordinates; vector integral calculus: line integral, surface integral volume integral, Green's theorem, Stoke's theorem, divergence theorem; implicit and inverse function theorems; Leibnitz theorem; calculus of variations (functionals of one variable).
5504321	Partial Differential Equations (3 credit hours)
	Prerequisite: 5504221 Introducing partial differential equations and their importance in many applied fields in science and engineering. The importance of mathematical modelling in representing, interpreting, controlling and predicting natural phenomena. This course covers the following topics : classification; some physical models (heat, wave, Laplace equations); separation of variables; Sturm-Liouville BVP; Fourier series, integrals and transforms; Homogeneous and nonhomogeneous problems, Infinite domain problems, BVP involving rectangular and circular regions; special functions (Bessel and Legendre); BVP involving cylindrical and spherical regions. Important applications such as weather forecasting, heat diffusion, vibrations, fluid mechanics, and many others.
5504337	Sampling Theory and its Applications (3 credit hours)
	Prerequisite: 5504131 Sampling surveys, population and sample design, data collection, sampling techniques (simple random sampling, regular sampling, stratified random sampling), estimation using ratio and regression, one-stage and two-stage cluster sampling.
5504341	Abstract Algebra (1) (3 credit hours)
	Prerequisite: 5504211 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 theorems.
5504342	Number Theory (3 credit hours)
	Prerequisite: 5504211 Definition of number theory and its importance historically and at present. This course covers the following topics: division algorithm; divisibility; greatest common divisor and least common multiple; Diophantine equations; prime numbers and their distribution; fundamental theorem of arithmetic; congruence; linear congruence equations; Chinese remainder theorem; tests of divisibility. Fermat little theorem; Wilson's theorem; arithmetic functions. Cryptography and data protection are an example of important and major applications of number theory.
5504344	Linear Algebra (2) (3 credit hours)
	Prerequisite: 5504241 Vector spaces; subspaces; quotient spaces; linear independence and bases; dual spaces; inner product spaces; orthonormal bases; linear transformations; eigenvalues, eigenvectors and determinants of linear transformations; matrix representation; change of basis and similarity; invariant subspaces; canonical forms of linear transformations; diagonal form; triangular form; nilpotent transformations; Jordan form; companion matrices; commutators; the trace functional and Jacobson's lemma; normal transformations and the spectral theorem.
5504352	Fuzzy Sets (3 credit hours)
	Prerequisite: 5504211 Definition of fuzzy sets, their foundation and evolution. Definition of fuzzy systems,

	<p>their types and their relationship to control theory. Some of the main applications of fuzzy systems, such as the control of self-driving metros or subways, cleaning and washing machines, aircraft, decision making. This course aims to familiarize students with the basic concepts of fuzzy sets and applications. The course includes: fuzzy Sets, Operations of fuzzy sets, Fuzzy relations and compositions of fuzzy relations, fuzzy graph and fuzzy relations, fuzzy numbers and operations on fuzzy numbers, fuzzy functions, fuzzy logic and some applications of fuzzy logic.</p>
5504371	<p>Linear Programming (3 credit hours) Prerequisite: 5504241</p> <p>This course aims to introduce the student to the basic concepts of linear programming. The course includes: the basics of linear programming; Mathematical formulation to real life problems. Graphical solution to the problem of linear programming in two variables, the simplex method; special cases in the simplex method; dual problems. Dual simplex, sensitivity analysis; Applications: the issue of transportation and communication.</p>
5504372	<p>Numerical Analysis (1) (3 credit hours) Prerequisite: 5504221+5504273</p> <p>This course is considered the first course in computational science and mathematics, and finding approximate numerical solutions to problems. Clarify and define the nature of numerical analysis and numerical methods and their applications. The following topics are studied and covered, error analysis, computer arithmetic operations, numerical solution to equations with one variable, approximation, calculus and numerical integration. Numerical methods in linear algebra. Apply numerical analysis to solve some physical, chemical and engineering problems. Combination between mathematical modeling and numerical solutions. One of the most important applications is weather forecasting and the study of climate changes.</p>
5504374	<p>Operation Research (3 credit hours) Prerequisite: 5504233</p> <p>Topics of the course include Markov chains, Queuing models including exponential models, Simulating real life problems that involve stochastic behaviour, Monte Carlo simulation.</p>
5504375	<p>Mathematical Modelling (3 credit hours) Prerequisite: 5504221</p> <p>This course aims to familiarize students with the basic concepts of Mathematics modelling. The course includes: Introduction, Mathematics classification of Models, constraints and terminology on Models, modelling process, population dynamics models for single species, stability analysis of growth models, Fishing management models, scaling variables, bifurcation analysis of the ODE $y' = f(y, c)$; saddle-node, trans critical and Pitchfork bifurcations, models from science and finance, Newton's law of cooling or heating, Chemical Kinetic reactions, modelling by systems of equations, modelling interacting species; model building, different types of interactions models.</p>
5504411	<p>Real Analysis (2) Prerequisite: 5504212</p> <p>Riemann integral and its existence. Sequences of functions: Convergence and uniform convergence; Approximation theorems (Stone, Weierstrass Theorems). Series of functions: Absolute and uniform convergence, Cauchy criterion, Weierstrass M-test, Dirichlet test and Abel test. Differentiation in IRP: Chain rule and mean-value theorem, inverse and implicit function theorems.</p>

5504412	Complex Analysis (3 credit hours)
	<p>Prerequisite: 5504212</p> <p>The structure of complex numbers (modulus, conjugate, polar form, roots, regions). Complex valued functions. (examples, limits, continuity). The derivative of a complex valued function. Formulas for differentiation. Cauchy - Riemann equations. Analytic functions (definition and basic 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. Morera's Theorem. Maximum modulus principle. Entire functions and Liouville's theorem. The fundamental theorem of algebra. Sequences and series of complex numbers (limits, convergence) Taylor series Laurent series. Absolute and uniform convergence of power series. Integration and differentiation of power series. Series representations of analytic functions on regions. Residues and Residue theorem. Poles. Residues at poles. Computations of residues. Improper integrals.</p>
5504415	Functional Analysis (3 credit hours)
	<p>Prerequisite: 5504411</p> <p>Metric spaces, examples of metric spaces, open sets, closed sets, neighbourhoods, convergence, Cauchy sequences, completeness, examples of complete metric spaces, completion of metric spaces, vector spaces, infinite dimensional vector spaces and subspaces, linearly dependent and independent vectors, Hamel basis, normed spaces, Banach spaces, properties of normed spaces, compactness and finite dimensional spaces, linear functionals, dual spaces, inner product spaces, Hilbert spaces, orthonormal sets and sequences, linear operators, bounded and continuous linear operators.</p>
5504421	Ordinary Differential Equations (2) (3 credit hours)
	<p>Prerequisite: 5504221</p> <p>Linear ordinary differential equations; existence and uniqueness theorems; infinite series solutions (Frobenius method); Bessel functions and Legendre Polynomials; Sturm-Liouville theory; Green's functions; linear systems with constant coefficients; non-linear differential equations and stability.</p>
5504424	Special Functions (3 credit hours)
	<p>Prerequisite: 5504301</p> <p>Series solutions of differential equations. Gamma and Beta functions, Legendre polynomials and functions, Bessel functions, Hermite and Laguerre polynomials, Chebyshev polynomials, Hyper geometric functions. Other special functions. Hyper-geometric functions. Other special functions.</p>
5504431	Mathematical Statistics (3 credit hours)
	<p>Prerequisite: 5504233</p> <p>Estimation: point estimation, confidence interval; statistical test: Neyman-Pearson Theorem, UMP test; likelihood ratio tests, chi-square tests, SPRT; non-parametric methods; Sufficient statistics and its properties; complete statistics exponential family; Fisher-Information and the Rao-Cramer inequality.</p>

5504442	Abstract Algebra (2) (3 credit hours)
	Prerequisite: 5504341
	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.
5504445	Graph Theory (3 credit hours)
	Prerequisite: 5504241
	Definition of graphs and examples, important types of graphs, operations on graphs, subgraphs and induced subgraphs, isomorphisms, adjacency and incidence matrices, connected graphs, Eulerian graphs, Hamiltonian graphs, planar graphs and the crossing number, domination number, clique number, chromatic number, independence number, matchings and Hall's marriage theorem, and applications. Applications such as: the network problem, the four-color problem, the traveling salesman problem.
5504446	Cryptology (3 credit hours)
	Prerequisite: 5504342
	Classical Cryptosystems such as: Shift ciphers, Affine ciphers, The Vigen`ere cipher, Substitution ciphers, The Playfair cipher, ADFGX cipher, and Block ciphers. One time pad, Pseudo-Random Bit Generation, and Linear feedback shift register. World War II ciphers such as: Enigma and Lorenz. Public key cryptosystems, The RSA, Primality testing and attack on RSA, The ElGamal Public key cryptosystem. Symmetric block cipher systems such as: DES and Rijndael. Digital Signatures such as: RSA signatures, The ElGamal signature scheme, and Hash functions. Elliptic curves and elliptic curves cryptosystems.
5504461	Non-Euclidean Geometry (3 credit hours)
	Prerequisite: 5504261
	Study of the parallel postulate and some of its equivalent statements. Hyperbolic geometry and some basic theorems. Spherical geometry and some basic theorems.
5504465	General Topology (3 credit hours)
	Prerequisite: 5504212
	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 compactness.
5504472	Numerical Analysis (2) (3 credit hours)
	Prerequisite: 5504372
	Numerical solutions of initial-value problems for ordinary differential equations, iterative techniques in matrix algebra, approximation theory, approximating eigenvalues.
5504481	Educational Mathematics (3 credit hours)
	Prerequisite: 5504341
	This course presents a set of basic concepts and theories in school education in general and mathematics education and teaching in particular. The course covers the following main topics: nature of Mathematics, Mathematical curriculum for schools, Planning to teach mathematics, Educational Objectives, Learning and teaching theories, Teaching Mathematical Knowledge, Assessment in Mathematics and evaluation.

5504482	History of Mathematics (3 credit hours)
	Prerequisite: 5504301 The emergence and development of some mathematical concepts, facts and algorithms in arithmetic, algebra, triangles, planar geometry, analytic geometry and calculus through ancient, Egyptian, Babylonian, Greek, Indian, Chinese, Islamic and European civilizations. Attempts to solve open problems and conjectures.
5504491	Special Topics in Mathematics (3 credit hours)
	Prerequisite: 5504212 This course presents a set of selected topics related to one of the fields of knowledge in mathematics, where topics complementary to some of the main subjects in the specialization are presented, or topics that keep pace with some recent developments in the specialization, in addition to some computer and physical applications.
5401201	Computer Skills for scientific faculties (3 credit hours)
	Prerequisites: 5411099 or 5401098 Principles of C++ programming, programming tools, variables, data types, loops, choices, decisions, matrices, functions, strings, C++ applications, weekly lab training.
5501101	General biology (1) (3 credit hours)
	Prerequisites: none The internal structure of the cell, molecules of the cell, metabolism, respiration & photosynthesis, cell-cell signaling, cell division, Mendelian inheritance, molecular biology of the gene, DNA technology, chemical signals in plants and animals, phylogeny & systematic introduction to the ecosystem.
5502101	General chemistry (1) (3 credit hours)
	Prerequisites: none Scientific Measurements; Stoichiometry; Chemical reactions, Atomic structure, Molecular structure, Periodic table, Chemical bonding, Gases and their laws, States of matter and forces among molecules.
5501103	General physics (1) (3 credit hours)
	Prerequisites: none Motion in one dimension, vectors, motion in two dimensions, the law of motions, Circular Motion and Other Applications of Newton's Laws, Energy and Energy Transfer, Potential Energy, Linear Momentum and Collisions, Rotation of a Rigid Object about a Fixed Axis, Angular Momentum, Gravitation, Fluid Mechanics.
5502221	Marine Sciences (3 credit hours)
	Prerequisites: none Detailed information on processes of biological, chemical, physical and geological that affect the marine environment for animal and marine plants.

