The University of Jordan

الجامعة الاردنية

Study Plan Ph.D. Program		
	Form Number	EXC-01-03-05A
	Issue Number and Date	2963/2022/24/3/2 5/12/2022
	Number and Date of Revision or Modification	15/10/2023
	Deans Council Approval Decision Number	265/2024/24/3/2
	The Date of the Deans Council Approval Decisio	2024/1/23
	Number of Pages	10

1.	School	**Science**
2.	Department	**Mathematics**
3.	Degree title (Arabic)	**دكتوراة في الرياضيات**
4.	Degree title (English)	**PhD in Mathematics**

Plan Number	Specialization #	Degree	Department #	School #	Year
2025	011	PhD	01	03	2025

First: General Rules & Conditions:

1. This plan conforms to valid regulations of the programs of graduate studies.
2. Specialties of Admission:
   - The First Priority: MSc in Mathematics
   - The Second Priority: MSc in Statistics

Second: Special Conditions:

None.

Third: Study Plan: Studying (54) Credit Hours as following:

1. Obligatory Courses (21) credit hours:

Course No.	Course Title	Credit Hrs	Theory	Practical	Nots	Pre/Co-requisite
0301901	Methods of Applied Mathematics	3	3	–	Face-to-face	–
0301911	Functional Analysis	3	3	–	blended	–
0301921	Matrix Analysis	3	3	–	Face-to-face	–
0301931	Mathematical Statistics	3	3	–	Face-to-face	–
0301941	Theory of Groups and Fields	3	3	–	Face-to-face	–
0301961	Topology	3	3		Face-to-face	–
0301971	Numerical analysis	3			Face-to-face	–

2. Elective Courses (15 Credits):

Course No.	Course Title	Credit Hrs	Theory	Practical	Nots	Pre/Co-requisite
0301902	Ordinary Differential Equations	3	3	–	Face-to-face	0301901
0301903	Partial Differential Equations	3	3	–	Face-to-face	0301901
0301905	Dynamical Systems	3	3	–	blended	--
0301906	Fractional Calculus	3	3	–	Face-to-face	0301901
0301907	Integral Equations	3	3	–	Face-to-face	0301901
0301912	Operator Theory	3	3	–	Face-to-face	0301911
0301914	Geometry of Banach Spaces	3	3	–	blended	0301911
0301915	Complex Analysis	3	3	–	Face-to-face	–
0301932	Probability Theory	3	3	–	Face-to-face	–
0301933	Information Theory	3	3	–	Face-to-face	–
0301934	Reliability Theory	3	3	–	Face-to-face	---
0301935	Stochastic Processes	3	3	–	Face-to-face	--
0301936	Design and Analysis of Experiments	3	3	–	Face-to-face	–
0301942	Commutative Algebra	3	3	–	Face-to-face	–
0301943	Algebraic Graph Theory	3	3	–	Face-to-face	–
0301944	Number Theory	3	3	–	Face-to-face	0301941
0301945	Rings of Continuous Functions	3	3	–	Online	–
0301962	Point Set Topology	3	3	–	Face-to-face	0301961
0301963	Algebraic Topology	3	3	–	Face-to-face	–
0301972	Modern Convex Optimization	3	3	–	Face-to-face	0301971
0301973	Integer and Combinatorial Optimization	3	3	–	blended	–
0301981	Special Topics in Mathematics	3	3	–	Online	Passing 9 credit hours

3. Pass the qualifying exam (0301998).

4. Dissertation: (18) Credit hours (0331999).

Course Description

Course Number 0301901	Course Title Methods of Applied Mathematics	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			**3**
Course Description Boundary value problems for ordinary and partial differential equations, integral transforms, Volterra and Fredholm equations, regular perturbation method.			

Course Number 0301902	Course Title Ordinary Differential Equations	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301901)			**3**
Course Description Existence and uniqueness, Poincare-Bendxion theory, stability theory of linear and almost linear systems, periodic solutions of ordinary differential equations, nonlinear equations and stability.			

Course Number 0301903	Course Title Partial Differential Equations	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301901)			**3**
Course Description General theory of first-order equations, the Cauchy problem, second-order equations: characteristics and normal forms, equations of mathematical physics, nonlinear eigenvalue problems and stability, advanced techniques of solutions.			

Course Number 0301905	Course Title Dynamical Systems	Type of Learning Blended	Credit Hours
Prerequisite: (None)			**3**
Course Description Fundamental concepts, extensive survey of examples, equivalence and classification of dynamical systems, principal classes of asymptotic invariants, circle maps, chaos.			

Course Number 0301906	Course Title Fractional Calculus	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301901)			3
Course Description Special functions of fractional calculus, Riemann-Liouville deferential and integral operators, Caputo's approach, Mittag-Leffler functions, fractional deferential equations, Numerical solutions of fractional deferential equations.			

Course Number 0301907	Course Title Integral Equations	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301901)			3
Course Description Symmetric kernels, properties and solutions, singular integral equations, Abel's types, transform methods, nonlinear integral equations, existence and uniqueness theorems, approximate solutions methods.			

Course Number 0301911	Course Title Functional Analysis	Type of Learning Blended	Credit Hours
Prerequisite: (None)			3
Course Description Banach and Hilbert spaces, Hahn-Banach, closed graph, open mapping, and uniform boundedness theorems, duality and weak topologies, convexity, Kerin-Milman theorem, elements of the spectral theory for bounded operators on Hilbert space, compact operators, spectral theorem for compact normal operators, Banach algebras, fixed point theorems.			

Course Number 0301912	Course Title Operator Theory	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301911)			3
Course Description Basic facts about operators on Hilbert space, spectral theorem for normal operators, shift operators, commutators and derivations, subnormal and hyponormal operators, operators in Schatten classes, Algebra of operators.			

Course Number 0301914	Course Title Geometry of Banach Spaces	Type of Learning Blended	Credit Hours
Prerequisite: (0301911)			3
Course Description Uniformly convex spaces, strict convexity and smoothness, Gateaux-differentiability of the norm, extreme, exposed and smooth points, best approximation in Banach spaces.			

Course Number 0301915	Course Title Complex Analysis	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Open mapping theorem. Positive harmonic functions. The Phragmen-Lindelof method and interpolation. Approximation by rational functions: Runge's theorem, Cauchy's theorem, simply connected regions. Zeros of holomorphic functions: infinite products, the Weierstrass factorization theorem, the Mittag-Leffler theorem, Jensen's formula, Blaschke products, the Muntz-Szasz theorem. Analytic continuation: Regular points and singular points, continuation along curve, The mondormy theorem, construction of a modular function, The Picard theorem. H^p-spaces(Hardy-spaces): Subharmonic functions, the space H^p and N (Nevanlinna class), the theorem of F. and M. Riez, factorization theorems, the shift operator, conjugate functions.			

Course Number 0301921	Course Title Matrix Analysis	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Majorization, eigenvalue and singular value inequalities, symmetric norms, spectral radius inequalities, numerical range, numerical radius inequalities, commutator estimates, arithmetic-geometric mean inequalities, Schwarz inequalities, perturbation of matrix functions.			

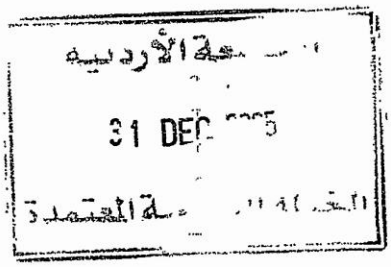
Course Number 0301931	Course Title Mathematical Statistics	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Theory of point estimation: unbiasedness, equivariance, resampling: bootstrap and Jackknife estimates, large sample theory, asymptotic optimality, theory of testing statistical hypotheses, the			

decision problem, uniformly most powerful tests, unbiasedness, invariance, minimax principles. Bayes methods and sequential analysis.

Course Number 0301932	Course Title Probability Theory	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Infinite divisible laws, matingales, ergodic theory, Markov chains, Brownian motion, renewal theorem, invariance theorem.			

Course Number 0301933	Course Title Information Theory	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Functional equations, classification of information measures, survey of well-known measures, required properties of information measures, axiomatic approach to characterizations of entropies, extensions of entropies to the continuous case, relationship measures, sufficient partitions and efficiency, maximum-entropy models, Akaiki information criterion and model selection, Kullback-Leibler divergence and testing statistical models.			

Course Number 0301934	Course Title Reliability Theory	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Coherent systems, reliability of coherent systems, classes of distributions of importance in reliability theory IFR, IFRA, NBU, NBUE, DMRL, and their dual classes, shock models, stress-strength models, preservation of life distribution classes under reliability operations, multivariate exponential distributions, maintenance policies, replacement models, some inference problems in reliability theory, limit distributions of coherent system life.			



Course Number 0301935	Course Title Stochastic Processes	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Definitions and terminology, classification, Markov chains (discrete and continuous Markov chains), renewal process, martingales, Brownian motion, branching processes, stationary processes, queueing theory, applications.			

Course Number 0301936	Course Title Design and Analysis of Experiments	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Basic ideas for good experimentation: randomization, replication and blocking, simple comparative experiments, one-way analysis of variance and multiple comparisons, orthogonal and polynomial contrasts, model validation and residual analysis, regression and analysis of covariance, factorial experiments and multi-way ANOVA, factorial designs with fixed, mixed and random effects, expected Mean squares and variance components, additivity and interactions, balanced and unbalanced designs, design efficiency, nested and crossed designs, complete and incomplete block designs, Latin square and factor effect confounding, split-plot and repeated measures designs, response surface and mixture designs, factorial designs and design resolution.			

Course Number 030941	Course Title Theory of Groups and Fields	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Further study of group theory: group actions, semidirect product, classification of finite groups, solvable, and nilpotent groups, splitting field of a polynomial, the Galois group, fundamental theorem of Galois theory; the general equation of the nth degree, finite ordered fields, real closed field.			

Course Number 0301942	Course Title Commutative Algebra	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Review of modules over commutative rings, chain conditions, projective and flat modules, localizations, domains and ideal theory, integral extensions, valuation rings.			

Course Number 0301943	Course Title Algebraic Graph Theory	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Review of basics in graph theory, matrices and graph theory, characteristic polynomial, chromatic polynomials, automorphism groups, symmetry and regularity of groups, graph enumerations, Polya theorem.			

Course Number 0301944	Course Title Number Theory	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301941)			3
Course Description Algebraic numbers, algebraic integers, trace, norm, discriminant, integral basis, prime factorization of ideals, Dirchlet unit theorem, ideal class group, Minkowski's bound.			

Course Number 0301945	Course Title Rings of Continuous Functions	Type of Learning Online	Credit Hours
Prerequisite: (None)			3
Course Description Ideals and z-filters, completely regular spaces, fixed ideals, compact spaces, ordered residue class rings, the Stone Cech compactification, characterization of maximal ideals.			

Course Number 0301961	Course Title Topology	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Quotient spaces and quotient mappings, function spaces, compactifications, Stone-Cech compactification, perfect mappings, Lindelof spaces, countably compact spaces, pesudocompact spaces and sequentially compact spaces, real compact spaces, paracompact spaces, countably paracompact spaces, weakly and strongly paracompact spaces.			

The University of Jordan

الجامعة الاردنية

Course Number 0301962	Course Title Point Set Topology	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301961)			3
Course Description [a,b]-compact spaces, spaces related to normal spaces, expandable spaces, generalizations of paracompact spaces and related spaces, product theorems, metrization theorems.			

Course Number 0301963	Course Title Algebraic Topology	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Homotopy theory, fundamental group, covering spaces, the fundamental group of some surfaces, applications, singular homology, the homotopy axiom, the Hurewicz theorem, exact homology sequences, the singular homology group, reduced homology, Mayer-Vietoris sequences, homology of some surfaces, simplicial complexes, CW-complexes, persistent homology, introduction to topological data analysis.			

Course Number 0301971	Course Title Numerical Analysis	Type of Learning Face-to-face	Credit Hours
Prerequisite: (None)			3
Course Description Approximation by spline functions, smoothing of data, the method of least squares, boundary-value problems for ordinary differential equations, shooting method, numerical solutions for nonlinear systems, minimization of multivariate functions, Newton's method, quasi-Newton methods, steepest descent methods, numerical solutions for parabolic and elliptic partial differential equations, finite-difference methods, introduction to finite-element methods.			

Course Number 0301972	Course Title Modern Convex Optimization	Type of Learning Face-to-face	Credit Hours
Prerequisite: (0301971)			3
Course Description Theory of constrained convex optimization including optimality conditions, duality theory, linear and cone programming applications and algorithms, interior-point methods, penalty and barrier methods.			

The University of Jordan

الجامعة الاردنية

Course Number 0301973	Course Title Integer and Combinatorial Optimization	Type of Learning Blended	Credit Hours
Prerequisite: (None)			3
Course Description Formulation and applications of integer and combinatorial optimization, relaxation, branch and bound, unimodularity, cutting plan, dynamic programming, integer programming duality, heuristic algorithms.			

Course Number 0301981	Course Title Special Topics in Mathematics	Type of Learning Online	Credit Hours
Prerequisite: (Passing 9 credit hours)			3
Course Description Topics to be chosen from various fields of mathematics.			

Inclusion rates in the program:

A. Courses that will be taught on the principle of full online:

Total hours that will be taught on the principle of full online in this program: (6 hours).

The percentage achieved for the subjects that will be taught on the principle of full online in this program: (17 %)

B. Subjects to be taught on the blended learning principle:

The total number of hours that will be taught on the principle of blended learning in this program: (12 hours)

Percentage achieved for subjects that will be taught on the principle of blended learning in this program: (33 %)

C. Face-to-face learning courses:

Number of hours of face-to-face education: (18 hours).