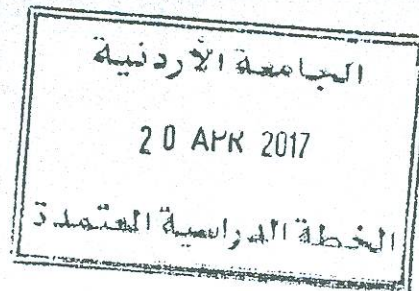# The University of Jordan

Accreditation & Quality Assurance Center

Curriculum for Master Degree

Program Name: Master in Mathematics

1.	Faculty	Science
2.	Department	Mathematics
3.	Program title (Arabic)	ماجستير في الرياضيات
4.	Program title (English)	**Master In Mathematics**
5.	Track	**Thesis Track**

| Plan Number			2016	MT

GENERAL RULES AND CONDITIONS:

1- This plan conforms to the regulations of the general frame of the Master programs.

2- Areas of specialty of admission in this program:

-Holders of the Bachelor of Science in:

(a) Mathematics.
(b) Mathematical Statistics.
(c) Education / Mathematics.

II.   SPECIAL CONDITIONS: None.

III.   THE PLAN:

1. Obligatory Courses (15 credit hours):

Course No.	Course Title	Credit hrs.	Pre-req.
0301701	**Applied Mathematics-1**	3	—
0301711	**Real Analysis**	3	—
0301731	**Mathematical Statistics**	3	—
0301741	Algebra-1	3	—
0301761	Topology-1	3	—
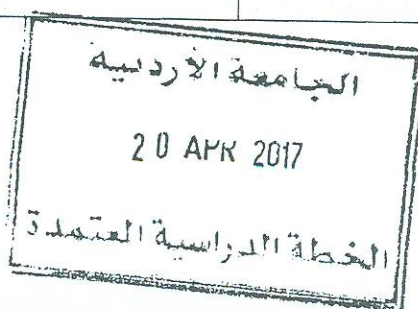
الجامعة الأردنية

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الخطة الدراسية المعتمدة

2. **Elective Courses: Studying (9 credit hours) from the following:**

Course No.	Course Title	Credit hrs.	Pre-req.
0301702	Applied Mathematics-2	3	0301701
0301712	Functional Analysis	3	0301711
0301713	Complex Analysis	3	–
0301714	Theory of Inequalities	3	–
0301721	Matrix Analysis	3	
0301732	Probability Theory	3	–
0301733	Nonparametric Statistics	3	–
0301734	Linear Statistical Models	3	–
0301742	Algebra-2	3	0301741
0301762	Topology-2	3	0301761
0301772	Nonlinear Optimization	3	--
0301781	Special Studies in Mathematics	3	–

3. **Dissertation: (9) Credit hours (0301799).**
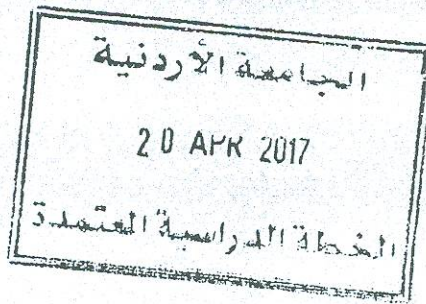
6.	Faculty	Science
7.	Department	Mathematics
8.	Program title (Arabic)	ماجستير في الرياضيات
9.	Program title (English)	**Master In Mathematics**
10.	Track	**Non-Thesis Track**

Plan Number			2016	MT

GENERAL RULES AND CONDITIONS:

1- This plan conforms to the regulations of the general frame of the Master programs.

2- Areas of specialty of admission in this program:

-Holders of the Bachelor of Science in:

(d) Mathematics.
(e) Mathematical Statistics.
(f) Education / Mathematics.

II.   SPECIAL CONDITIONS: None.

III.   THE PLAN:

1.   Obligatory Courses (24 credit hours):

Course No.	Course Title	Credit hrs.	Pre-req.
0301701	**Applied Mathematics-1**	3	—
0301711	**Real Analysis**	3	—
0301713	**Complex Analysis**	3	—
0301721	**Matrix Analysis**	3	—
0301731	**Mathematical Statistics**	3	—
0301732	**Probability Theory**	3	—
0301741	Algebra-1	3	—

الجامعة الأردنية

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الخطة الدراسية المعتمدة

3

0301761	Topology-1	3	–

2. Elective Courses: Studying (9 credit hours) from the following:

Course No.	Course Title	Credit hrs.	Pre-req.
0301702	Applied Mathematics-2	3	0301701
0301712	Functional Analysis	3	0301711
0301714	Theory of Inequalities	3	–
0301733	Nonparametric Statistics	3	–
0301734	Linear Statistical Models	3	–
0301742	Algebra-2	3	0301741
0301762	Topology-2	3	0301761
0301772	Nonlinear Optimization	3	--
0301781	Special Studies in Mathematics	3	–

3. Passing the Comprehensive Exam (0301798).
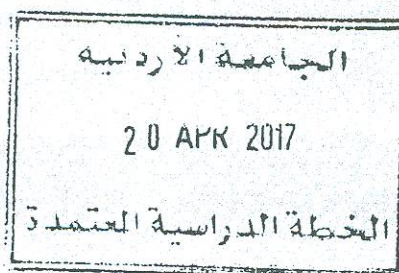
COURSE DESCRIPTION
MASTER IN (MATHEMATICS)

(Thesis & Non-Thesis Tracks)

0301701 Applied Mathematics-1   **3 Credit Hors.**

Prerequisite: None.
Review of ODEs, existence and uniqueness of solutions for ODEs,
Integral Transforms, Green's Function, Approximation Methods, non-
linear ODEs and their stability.

0301702 Applied Mathematics-2   **3 Credit Hors.**
Prerequisite: (0301701)
PDEs of Mathematical Physics, separation of variables, Transform
Methods, Eigen function expansions, Green's Function,
Approximation Methods, Integral Equations.

0301711 Real Analysis   **3 Credit Hors.**

Prerequisite: None.
Lebesgue measure: outer measure, measurable sets and functions,
Egoroff's theorem, Lusin's theorem, convergence in measure, the
Lebesgue integral: the integral of a bounded function over a set of
finite measure, the integral of a nonnegative function, the general
Lebesgue integral, Riemann and Lebesgue integrals, differentiation:
differentiation of monotone functions, functions of bounded
variation, differentiation of an integral, absolute continuity, Lp
classes: the Holder and Minkowski inequalities, completeness of Lp
classes, the duals of Lp classes, Banach spaces: linear operators, the
Hahn-Banach theorem and other basic results, Hilbert spaces.

0301712 Functional Analysis   **3 Credit Hors.**

Prerequisite:(0301711)

Hilbert spaces: the geometry of Hilbert space, the Riesz
representation theorem, orthonormal bases, isomorphic Hilbert
spaces, operators on Hilbert space: basic properties and examples,

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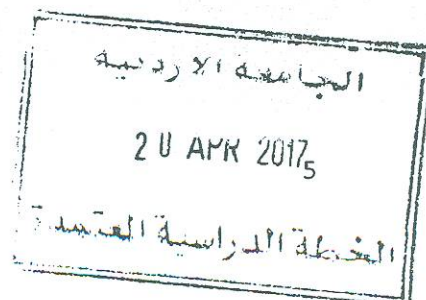
adjoints, projections, invariant and reducing subspaces, positive operators and the polar decomposition, self-adjoint operators, normal operators, isometric and unitary operators, the spectrum and the numerical range of an operator, operator inequalities, compact operators, Banach spaces: basic properties and examples, convex sets, subspaces and quotient spaces, linear functionals and the dual spaces, the Hahn-Banach theorem, the uniform boundedness principle, the open mapping theorem, and the closed graph theorem.

0301713   Complex Analysis   3 Credit Hors.

Prerequisite: None.
Analytic functions: power series, Laurent series, analytic functions as mappings, Mobius transformations, linear fractional transformations, conformal mappings, cross ratio, complex integration: zeros of analytic functions, Cauchy's theorem and formula, the argument principle, the open mapping theorem, the maximum modulus principle, Schwartz lemma, singularities: classification of singularities, residues, residue theorem, evaluation of real definite and improper integrals, normal families: Riemann mapping theorem, Schwartz reflection principle, Schwartz-Christofell formulas, harmonic functions: Dirichlet problem, Poisson's formula, mean value property.

0301714   Theory of Inequalities   3 Credit Hors.

Prerequisite: None.
Classical inequalities: convex functions, Jensen's inequality, Young's inequality, Holder's inequality, Minkowski's inequality, inequalities related to Cauchy-Schwarz inequality, Kantorovich's inequality, means: classical means, weighted means, applications, bounds for the zeros of polynomials: location of the zeros of polynomials, classical bounds, Cauchy's bound, Montel's bound, Carmichael-Mason's bound, Kakeya's bound, Kojima's bound, bounds from matrix inequalities, recent bounds, noncommutative inequalities for matrices, miscellaneous bounds.

0301721   Matrix Analysis   3 Credit Hors.

Prerequisite: None.
Similarity and canonical forms, diagonalization and simultaneous

diagondization of matrices, location of eigenvalues, special classes of matrices, unitary equivalence of matrices, Schur's theorem and spectral theorem, singular value decomposition and polar decomposition, generalized inverses, least-squares solutions to linear systems, determinant and trace inequalities, the min-max principle, singular value inequalities, perturbation inequalities, vector and matrix norms, the spectral radius and the numerical radius, unitarily invariant norms, norm inequalities, the Löwner ordering of Hermitian matrices, Hadamard product of matrices, applications.

0301731   Mathematical Statistics   3 Credit Hors.

Prerequisite: None.
Univariate and multivariate distribution theory, sufficient statistics, minimal sufficient statistics, completeness, methods of point estimation and properties of point estimators, confidence, intervals, testing hypotheses, Neman-Pearson lemma, randomized tests, uniformly most powerful test, likelihood ratio tests, mimimax methods.

0301732   Probability Theory   3 Credit Hors.

Prerequisite: None.
Kolmogorrov's axioms, random variables, distributions, expected values, conditional probability, independence, Borel-Cantelli lemma, characteristic functions and inversion formula, convergence concepts, laws of large numbers, central limit theorems.

0301733   Nonparametric Statistics   3 Credit Hors.

Prerequisite: None.
Distribution free statistics, counting and ranking statistics, one-sample and two sample U-statistics, power function and nonparametric alternatives, Pitman asymptotic relative efficiency, Noether's theorem, confidence intervals and bounds, Hodges-Lehman location estimators and their asymptotic properties, linear rank statistics and distribution properties, two-sample location and scale problems, other important problems.

0301734   **Linear Statistical Models**   **3 Credit Hors.**

Prerequisite: None.
Normal equations and least squares estimation, solution of normal equations by generalized matrix inverse, invariant and estimable linear parametric functions, multidimensional normal distribution, noncentral Chi-square distribution, distribution of linear and quadratic forms, independence of several quadratic forms and orthogonality, full rank and less than full rank linear models, analysis of variance for linear models, variance components and mixed models, Gauss-Markov and BLUE estimators.

0301741   **Algebra-1**   **3 Credit Hors.**

Prerequisite: None.
Isomorphism theorems of groups, group automorphism, finite direct products, finitely generated groups, groups actions, Sylow theorems, rings and ideals, prime and maximal ideals, polynomial rings and irreducibity tests, unique factorization domains, Euclidean domains.

0301742

   Algebra-2   **3 Credit Hors.**

Prerequisite: (0301741)
R-modules, products and sums of R-modules, exact sequences and split exact sequences, simple and semisimple R-modules, essential and small submodules, the ring of endomorphisms of an R-modules, projective and injective modules, regular rings, the radical and socle of an R-module, Noetherian and Artinian R-modules. Field extensions, algebraic elements, splitting fields.

0301761   **Topology-1**   **3 Credit Hors.**

Prerequisite: None.
Topological spaces, neighborhoods, bases and subbases, continuous functions, product spaces, weak topologies, quotient spaces, filters, separation axioms, regular and completely regular spaces, normal and perfectly normal spaces, Lindelof, separable spaces and second countable spaces, compact spaces, locally compact spaces, sequentially and countably compact spaces, one point

compactification, paracompact spaces, connected spaces.

0301762   Topology-2   **3 Credit Hors.**

> **Prerequisite:(0301761)**

Locally compact and k-spaces, Čech complete spaces, metric and metrizable spaces, complete metric spaces and the completion theorem, Baire spaces and Baire category theorem, uniform and proximity spaces.

0301772   Nonlinear Optimization   **3 Credit Hors.**

> **Prerequisite: None.**
> Theory and algorithms for unconstrained nonlinear optimization problems, including line search, trust region, conjugate gradient, Newton and quasi-Newton methods.

0301781   Special Studies in Mathematics   **3 Credit Hors.**

> **Prerequisite: None.**
> Topics to be chosen from various fields of Mathematics.