Brief course description- Course Plan Development and Updating Procedures\ Mathematics Department	QF01/0409-3.0E

Faculty	Sciences and Information Technology	Academic Department	Mathematics	Number of the course plan (1)
Number of Major requirement courses	17	Date of plan approval	11/11/2019	

This form is just for the major requirement courses

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101711	3	Real Analysis	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.			

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101713	3	Complex Analysis	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.			

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101712	3	Functional Analysis	0101711
Hilbert spaces, the geometry of Hilbert spaces , the Riesz representation theorem, orthonormal bases, isomorphic Hilbert spaces, operators on Hilbert space: adjoints, projections, invariant and reducing subspaces, positive operators and the polar decomposition, selfadjoint operators, normal operators, isometric and unitary operators, the spectrum and the numerical range of an operator, operator inequalities, compact operators, basics of Banach spaces especially commutative ones, convex sets and the Krein-Milman theorem, subspaces and quotient spaces, linear functionals and the dual spaces, the Hahn-Banach theorem in all its various forms, the uniform boundedness principle, the open mapping theorem, and the closed graph theorem.			

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101714	3	Mathematical Optimization	None
Linear programming and mathematical modeling, the simplex method, duality, convexity, constrained and unconstrained nonlinear programming problems, Lagrange multipliers, Kuhn-Tucker conditions, quadratic programming.			

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Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101721	3	Abstract Algebra (1)	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.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101722	3	Abstract Algebra (2)	0101721

Rings and ideals, nilpotents and idempotents in rings, 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 the socle of an R-module, Noetherian and Artinian R-modules.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101731	3	Topology (1)	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.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101732	3	Topology (2)	0101731

Locally compact and K-Spaces, Cech complete spaces, metric and metrizable spaces, complete metric spaces and the completion theorem, Baire spaces and Baire category theorem, uniform and proximity spaces.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101741	3	Applied Mathematics (1)	None

Review of ODEs, existence and uniqueness of solutions for ODEs, Integral Transforms, and Green's Function, Approximation Methods, non-linear ODEs and their stability.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101742	3	Applied Mathematics (2)	0101741

PDEs of Mathematical Physics, separation of variables, Transform Methods, Eigen function expansions, Green's Function, Approximation Methods, Integral Equations.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101743	3	Combinatorial Mathematics	None

Counting principles, the binomial theorem, recurrence relations, generating functions, graph theory, coding theory.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101744	3	Advanced Numerical Analysis	None

Data Fitting (polynomial interpolation, least squares method); Numerical methods for ordinary and partial differential equations (Euler , Runge-Kutta formulas, Boundary value problems, finite difference methods); Numerical Linear Algebra (LU, Cholesky, QR and singular value decompositions); Eigenvalue problem (Power method, Lanczos algorithm).

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101751	3	Mathematical Statistics	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, minimax methods.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101752	3	Probability Theory	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.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101761	3	Matrix Theory	None

Similarity and canonical forms, diagonalization and simultaneous diagonalization 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.

Course number	Credit hours	**Title of the course**	Prerequisite-co-requisite
0101771	3	Selected Topics in Mathematics	None

Study of selected areas in mathematics. Designed for special needs of advanced students.

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Course number	Credit hours	Title of the course	Prerequisite-co-requisite
0101772	3	Scientific Research Methodology	None
The course aims to provide in-depth knowledge of research design and methodology and train the student in writing a study plan and critically reviewing scientific literature.			

Approved by department council	1-6/2019/2020	Date of approval	11/11/2019