

Department of Mathematics

Master Program Courses Description

0302500- *Scientific Research Methods.* (3 credits)

Preq. None

0302501- *Theory of differential equations (1).*(3 credits).

Existence and uniqueness of solutions of differential equations.

Existence and uniqueness of solutions for systems of differential equations.

Existence and uniqueness of solutions for linear differential equations of order (n).

Dependence of solutions of differential equations on function and initial conditions.

Independent systems.

Sturm-Liouville theorem and orthogonal functions.

Stability of linear and non-linear systems.

Liapounov's method.

Preq. none

0302502- *Theory of differential equations (2).*(3 credits).

Nonlinear systems: Local theorem.

Nonlinear systems: Global theorem.

Nonlinear systems: Bifurcation theorem.

Preq. 0302501.

0302503- *Partial differential equations(1)* (3 credits).

Theory and analytic treatment of elliptic equations and related topics.

Preq. 0302501.

0302504- *Partial differential equations(2)* (3 credits).

Theory and analytic treatment of parabolic, and hyperbolic equations and related topics.

Preq. 0302503.

0302509- *Selected topics in differential equations. Study of some special topics in differential equations.* Preq. 0302501.

0302511- *Measure theory and integration (1)* (3 credits).

Outer measure. Measurable sets and Lebesgue measure. Measurable functions.

The Lebesgue integral. The integral of a nonnegative function. The general

Lebesgue integral. Convergence in measure. Differentiation and integration.

Differentiation of monotone functions. Differentiation of an

integration. Absolute continuity. The L^p spaces.

The Holder and Minkowski inequalities. Convergence and completeness property. Preq. None.

0302512- *Functional Analysis* (3 credits).

Normed spaces.

Banach spaces.

Inner product spaces.
Hilbert spaces.
Fundamental theorems for normed and Banach spaces.
Banach fixed point theorem.
Spectra of linear operators in normed spaces.
Preq. None.

0302513- *Complex Analysis (1)* (3 credits).

Holomorphic and meromorphic functions on plane domains.
Harmonic and sub-harmonic functions.
Cauchy theorem.
Residue theorem.
Argument principle.
Maximum modulus principle.
Reflection principle.
Series of holomorphic and meromorphic functions including Taylor and Laurent series expansions.
Preq. None.

0302514- *Complex Analysis (2)* (3 credits)

Monodromy theory and analytic continuation.
Normal families of analytic functions.
Riemann mapping theorem.
Picard's theorem.
Infinite products.
Entire functions.
Elliptic functions.
Dirichlet problem.
Green's function.
Conformal mappings.
Introduction to Riemann surfaces.
Multivariable complex functions.
Preq..0302513

0302515- *Measure theory and integration (2)* (3 credits)

Introduction in measure and integration.
Measure spaces.
Measurable functions.
Integrations.
Signed measures.
The Radon- Nikodum theorem.
 L^p - spaces.
Outer measure .
The extension theorem.
The Lebesgue-Stieltjes integral.
Product measures .
Preq 0302511

0302516- *Theory of Operators* (3 credits)

Spectral theory of linear operators in normed spaces.

Compact linear operators on normed spaces and their spectrum.
Spectral theory of bounded self-adjoint linear operators.
Unbounded linear operators in Hilbert spaces.
Unbounded linear operators in quantum mechanics.
Preq. 302512

0302517- *Abstract Harmonic Analysis* (3 credits)

Topological groups.
Haar measure and Integral.
Modular functions.
Convolution of measures and functions.
Fourier transforms on topological groups.
Mean properties, inversion theorem in L^1 , L^2 and L^p , -spaces .
Preq. 0302512

0302518- *Selected Topics in Complex analysis* (3 credits)

Topics selected from: Riemann surfaces.
Quasiconformal mappings,
Multivariable complex functions.
Fox groups.
Cline groups.
Riemann surfaces.
Analytic spaces.
Theory and abstract of functions.
Preq. 0302514

0302519- *Selected Topics in Real Analysis* (3 credits)

Topics Selected from: Sobolev spaces and functions of bounded variation.
Calculus of Variations and Operator Algebra
Preq 0302511

0302521- *Numerical Analysis* (3 credits).

Solution of nonlinear equations.
Interpolation and polynomial approximation.
Lagrange interpolation.
Divided difference.
Hermite interpolation.
Numerical differentiation and integration.
Ordinary differential equations.
Initial value problem.
Solution of partial differential equations.
Preq. None.

0302523- *Orthogonal polynomials* (3 credits)

Elementary properties of orthogonal polynomial.
Special systems of orthogonal polynomials.
Hambourger Stieltjes moments problem.
Mechanical quadrature and averaging on the zeros of orthogonal polynomials.
Series of orthogonal polynomials.

Preq. None.

0302531- Probability Theory (3 credits)

Mathematical expectation and moment generating function, Joint and conditional distribution, Independence and expectation, Characteristic functions, Limit and convergence, Central limit theorem, Some results on Convergence.

Preq. None.

0302532- Mathematical Statistics (3 credits)

Univariate and multivariate distribution theory, sufficient statistics and information in the sample, Properties of point estimation, Methods of estimation, Interval of estimation, Tests of hypothesis, theory of statistical tests.

Preq. 0302531.

0302533- Nonparametric Statistics (3 credits)

Order statistics and related distributions, point and interval estimation, goodness of fit, Randomness, One and two sample locations tests, Tests of K populations, Tests of independence

Preq. 0302531.

0302534-Time series (3 credits)

Stationary, Stationary and non stationary probability models for time series (AR, MA, ARMA, ARIMA) , Box Jenkins methodology, Stationary Processes in the frequency domain, Spectral Analysis.

Preq. 0302531.

0302535-Linear statistical methods (3 credits)

Some elementary theorems and results in matrix algebra, Distribution of quadratic forms, General linear model of full rank and less than full rank.

Preq. 0302531.

0302539-Special Topics in Statistic and probability (3 credits)

Any subject in statistics approved by the Department.

Preq. None.

0302541-Abstract Algebra (1) (3 credits)

Groups.

Free, abelian, and alternating groups,
Sylow Theorems and its applications.

Simple groups.

Finitely generated abelian groups.

Euclidean Domains.

Principal Ideal domains.

UFD. Finite fields.

Extension fields.

Splitting fields.

Finite fields.

Groups of Automorphisms of extension fields.

Preq. None.

0302542- Abstract Algebra (2) (3 credits)

Fields.
Algebraic and transcendental extensions.
Galois theory.
Splitting fields.
Separable extensions.
Galois fields.
Preq. 0302541.

0302543- Abstract Algebra (3) (3 credits)

Rings.
Complete rings.
Euclidian complete rings.
Analytic complete rings.
Noetherian rings.
Artinian ring.
Hilbert's Basis Theorem.
Initial splitting.
Hilbert's zeros theorem.
Roots group.
Semi-simple rings.
Wedderburn theorem.
Irreducible rings.
Completely reducible rings
Group rings.
Maschke theorem.
Preq. 0302542

0302544-Homological Algebra (3 credits)

Rings,Modules.
Homomorphism of rings.
Free, projective and injective modules.
Categories and functions.
Products and co-products.
Contractions.
Adjoint functions.
Abelian categories.
Extensions of modules.
The functor (ext,tor).
derived functors.
The tensor product.
Complexes.
Homology and cohomology functors resolutions.
Preq. 302541

0302545-Theory of Algebraic Numbers (3 credits)

Algebraic number fields.

Algebraic integers and integral bases.
Integral algebraic elements.
Factorization of algebraic integers.
Ideals in an algebraic number fields,
Unique factorization of ideal theory.
Quadratic fields.
Preq, 0302541

0302546-Introduction to *group representations* (3 credits)

Introduction to the theory of representation of finite groups.
representations of groups .
Permutation representation of groups matrix.
Irreducible and completely reducible representations.
Equivalent representations.
Character of a representation.
The orthogonality relations.
The character table.
Some applications.
Induced representations.
Frobenius reciprocity theorem on induced characters.
Preq. 0302541

0302547-*Algebraic Geometry* (3 credits)

Affine varieties.
Hilbert basis theorem.
Hilbert's Nullstellensatz.
Local properties of plane curves.
Projective varieties.
Bezout's theorem.
Riemann-Roch theorem.
Preq. 0302541

0302549-*Selected topics in Abstract Algebra* (3 credits)

Selected topics from general group theory.
Theory of group representations.
Galois theory.
Module theory algebraic number theory.
Preq. 0302541

0302651- *General Topology (1)* (3 credits)

A quick revision of the basic concepts.
Neighborhood systems.
General product spaces.
Tychonoff topology.
Bbox topology.
Quotient topology and identification spaces.
Sequences and convergence in first countable spaces.
Inadequacy of sequences.
Nets.
More on separation axioms.

Jone's Lemma.
 Urysohn's Lemma.
 Tietze theorem.
 More on countability axioms.
 Covering properties: Compact spaces, countable compact spaces, sequentially compact spaces.
 Lindeloff spaces.
 Locally compact spaces.
 One-point compactification.
 Paracompact spaces.
 Metric spaces.
 Product of metrizable spaces.
 Complete metric spaces and completion's.
 The Baire theorem.
 Homotopy paths.
 Fundamental group.
 Covering spaces.
 The fundamental group of the circle.
 Preq. None.

302562- General Topology (2) (3 credits)

Compactifications, the Stone-Cech compactification.
 Metrizable, Urysohn's metrization theorem.
 Full normality and A.H. Stone's coincidence theorem.
 Alexandruff-Urysohn metrizations theorem.
 Spaces, Bing's metrization theorem of Moore spaces, Moore metrization theorem. Uniform spaces, Uniform topology, Uniform covers.
 Operations on Uniform spaces, Uniform continuity.
 Uniformization, Metrizable of uniform spaces.
 Totally bounded and complete uniform spaces.
 Completion.
 Function spaces.
 Pointwise convergence, Uniform convergence.
 Uniform metric.
 Compact open to equicontinuity and compactness of a space of functions.
 The Stone-Weierstrass theorem.
 Dimension of topological spaces, the dimensions ind , Ind , dim , More on dimension, dimension of metrizable spaces.
 Preq. 0302561.

0302563-Algebraic Topology (1) (3 credits)

Homotopy Theory.
 Contractible spaces.
 Retract and strong deformation retract.
 Manifolds.
 Special Euler function.
 The fundamental group.
 The fundamental group of S^1 .
 Brouwer fixed point theorem.

The fundamental group of the surfaces.
Covering spaces.
Preq. 0302541 and 0302561

0302564-*Algebraic Topology (2)* (3 credits)

Homology Theory.
Singular homology groups.
Mayer-Vietories sequences.
The jordan separation theorem.
CW-Complexes.
The homology of CW-complexes.
The Eilenberg-Steenrod axioms.
Poincaré duality.
Applications on the fixed point theorem.
The Lebesgue fixed point theorem.
Preq. 0302563

0302565-*Dimension Theory* (3 credits)

Small dimension ind, Large inductive dimension Ind.
Covering dimension dim.
Basic properties and the connection between Ind, Ind. and dim, Subspaces,
Dimension of compactifications.
Strongly zero-dimensional spaces.
Results on products.
Unions and sums in dimension theory .
Preq. 0302561

0302569-*Selected Topics in Topology* (3 credits)

Selected topics from different areas in topology like n , m -compact spaces.
Paracompact spaces.
Dimension theory and fixed point theory.
Preq. 0302561

0302573-*Elasticity Theory* (3 credits)

Review of stress and strain analysis.
General Hooke's law.
Variational principle.
Flexure and torsion of beams.
Bending of plates and shells.
Preq.0302501

0302575-*Approximation Theory* (3 credits)

Uniform approximation.
Least-squares approximation.
Mechanical quadrature and averaging.
Approximation by cross sections.
Rational approximation.
Preq. 0302511

0302576- Graph Theory (3 credits)

Oriented Linear Graphs.
Non-Oriented linear Graphs.
Incidence set and cut-set.
Static Maximal Flows.
Preq. None

0302577-Operations Research (1). (3 credits)

Introduction to mathematical techniques in operations research.
Topics from discrete optimization theory.
Graphs and network theory.
Linear and non-linear programming.
Queuing theory.
Inventory theory.
Decision theory and simulation.
Preq. None

0302578-Operations Research (2). (3 credits)

Topics may include but are not limited to, Karmarkar's algorithm and other interior point methods. Matroid theory. Nonlinear optimization. Multiple objective optimization. Dynamic programming. Combinatorial optimization
Preq. 0302577

0302579-Selected Topics in Applied Mathematics (3 credits)

Selected Topics in Applied Math. Fields like Oscillation theory. Perturbation analysis. Numerical analysis and optimum control. Preq. 0302501

0302598-Comprehensive Exam (zero credit)

0302599-Master Thesis (9 credit)