• Department of Mathematics

1. Educational Goal

1) To educate good intellectuals and competent researchers with expert knowledge of mathematical research.

2) To educate talented individuals who can develop ingenious skills and make academic contributions to some fields of mathematics.

3) To educate professionals who are necessary for various fields according to industrial development.

2. Educational Objective

1) Master's Course

① To cultivate basic knowledge which is fundamental for mathematical research.
② To acquire mathematical knowledge and be trained to research mathematics.
③ To develope creative thinking and knowledge in order to cultivate qualities that is necessary for research of mathematics.
④ To acquire a wide range of mathematical knowledge in order to work in the fields of applications of mathematics.

2) Doctor's course

① To understand the current trend of modern mathematics.
② To develop the ability to continuously pursue research on a given subject in a field.
③ To contribute the development of mathematics through the development of creative and novel theories.
④ To nurture a mathematician who is suitable for the modern society that can solve the problems in cooperation.

3) Master's and Doctorate Course

① To acquire basic knowledge of mathematics and systematic understanding of modern mathematics.
② To get ability to develop creative theories and to continue research on some fields.
③ To nurture a mathematician who is suitable for the modern society that can solve the problem in cooperation

• **List of Full-time Faculty**

Name	Position	Degree(University)	Field of Instruction	Area of Research
Rhie, Gil Seob	Professor	Ph.D. (Korea Univ.)	Analysis	Analysis
Choi, Eun Mi	Professor	Ph.D. (Thfts Univ.)	Algebra	Abstract algebra, Number theory & cryptography
Kim, Sang Bae	Professor	Ph.D. (Purdue Univ.)	Applied mathematics / Analysis	Numerical solution of PDE, Iterative Methods
Ryoo, Cheon Seoung	Professor	Ph.D. (Kyushu Univ.)	Applied mathematics / Analysis	Numerical verification, p-decimal functional analysis
Kim, Hwa Jeong	Associate Professor	Ph.D. (Saarland Univ.)	Differential geometry	Minimum surface, spin geometry, singular manifold
Roh, Kum Hwan	Assistant Professor	Ph.D. (KAIST)	Financial mathematics	Derivatives pricing, Portfolio selection problem
Lee, Hui Young	Assistant Professor	Ph.D. (Hannam Univ.)	Analysis	Polynomials and Numbers in Complex and P-adic Fields
Kim, Ji Hyun	Associate Professor	Ph.D. (KAIST)	Numerical analysis	Development of various finite element methods and error analysis
Piao, Xiangfan	Assistant Professor	Ph.D. (Kyungpook National Univ.)	Numerical analysis	Numerical solution of initial value problem and time dependent PDE

4. Course Description

- **MA601 General Topology I 3 credits**

  Metric Spaces, Topological Spaces, Subspaces, Connectivity and Components, Separation Axioms, Nets, Compactness, Products, Quotient Spaces

- **MA602 Algebraic Topology 3 credits**

  Geometric Complexes and Polyhedra, Simplicial Homology Groups, The Euler-Poincare Theorem, Simplicial Approximation, The fundamental Group, The relation between and Covering spaces, Universal covering spaces, The higher Homopoty groups

- **MA603 Complex Analysis I 3 credits**

  Complex numbers, Polar form, Exponential form, Powers and roots, Functions of complex variable, Limits, Continuity, Derivatives, Differentiation formulas, Cauchy-Riemann equations Polar coordinates, Analytic functions, Harmonic functions, Trigonometric functions, Hyperbolic functions, The Logarithmic function and its branches, Integrals, Cauchy-Goursat Theorem, Cauchy Integral Formula, Liouville's Theorem, Morera's Theorem

- **MA604 Complex Analysis Ⅱ 3 credits**

  Convergence of sequences and series, Taylor series, Laurent series, Uniform convergence, Residues Theorem, Principal part of a function, Residual at Poles, Quotients of Analytic Functions, Improper Integrals, Definite Integrals, Linear Functions, Linear Fractional Transformations

- **MA605 Ordinary Differential Equation 3 credits**

  First-order differential equations, linear differential equations with constant coefficients, first-order systems of differential equations with constant coefficients, numerical methods, Laplace transforms, series solutions, algebraic systems of equations

- **MA606 Partial Differential Equation 3 credits**

  Discussion of the solution, Linear second-order partial differential equations in two variables, Some properties of elliptic and parabolic equations, Laplace's equation, Green's theorem, The maximum principle, The heat equation, Separation of variables and Fourier series, Nonhomogeneous problems, Sturm-Liouville theory, Analytic functions

- **MA607 Numerical Analysis 3 credits**

  iterative methods, convergence of iterative methods, Gauss elimination, Lagrange interpolation, spline function, B-spline, numerical differentiation, numerical integration.

· MA608 Mathematical Statistics 3 credits

Some topics in probability, statistical models, Methods of estimation, Comparison of estimates-optimality theory, From estimation to confidence intervals and testing, optimal tests and confidence interval, Linear models, analysis of discretedata, nonparametric models

· MA609 Fourier Analysis 3 credits

Boundary value problems, Fourier series and applications, Orthogonal functions, Gamma, Beta and other special functions, Fourier integrals and applications, Bessel Functions and applications, Legendre functions and applications

· MA610 Measure Theory 3 credits

Lebesgue Outer Measures, Measurable sets, Regularity, Borel and Lebesgue measurability, Measurable Functions, Hausdorff Measures, The Riemann and Lebesgue integral, The General Integral, Differentiation, Abstract Measure Spaces, Convergence, Signed Measures and their Derivatives, Measure and Integration in a Product Spaces

· MA611 Financial Mathematics 3 credits

· MA612 Algebra Ⅰ 3 credits

Group, Normal subgroup, Homomorphism, Sylow theory, Finite abelian group, Ring, Ideal, Integral domain, Unique factorization domain, Euclidean domain, Quotient ring, Field of quotient.

· MA613 Algebra Ⅱ 3 credits

Module, Group algebra, Field, Maximal ideal, Prime ideal, Field extension, Simple extension, Finite field extension, Galois group, Splitting field, Separable extension, Galois extension

· MA614 Ring an Module 3 credits

Ring, Ideal, Module Factor Module, Homomorphisms of Rings and modules, Free module, Injective and Projective module, Artinian and Noetherian module, Local Ring, Radical and Socal, Semisimple ring.

· MA615 Real Analysis Ⅰ 3 credits

Outer Measures, Measurable sets, Lebesgue measure, Measurable Functions, The Riemann integral, Functions of bounded variation, Differentiation of an integral, Absolute continuity, Convex functions, The classical Banach Spaces

· MA616 Real Analysis Ⅱ 3 credits

Measure space, Measurable Functions, Integration, Signed measures, The Radon-Nikodym Theory, Lebesgue-Stieltjes integral, Product measure, Hausdorff measure, Measure and Topology, Invariant Measure, Mappings of Measure Spaces

· MA617 Functional Analysis Ⅰ 3 credits

Metric spaces, Banach's fixed point theorem, Vector spaces, Linear maps, Normed spaces, Compact operators, Dual systems, Quotient spaces, Fredholm operators

· MA618 Probability Theory Ⅰ 3 credits

Fundamentals of measure and integration theory, Basic concepts of probabconditional probability and expectation, strong Laws of large numbers and martingale theory, The central limit theorem.

· MA619 General Topology Ⅱ 3 credits

Locally compact spaces, Paracompact Spaces, Fuction spaces, Point open Topology, Compact open Topology, Homotopy, Topological groups, Metrization, The Baire Category theorem

· MA620 Geometry 3 credits

Euclid's Geometry, Hilbert's axioms, Neutral Geometry, History of the parallel Postulate, The discovery of Non-Euclidean Geometry, Affine Geometry, Projective Geometry, Hyperbolic Geometry

· MA621 Differential Geometry 3 credits

Vector fields, curvature and torsion, Frenet-Serret theorem, intrinsic equations, concepts of surfaces, first fundamental form, second fundamental form, normal curvatures, Dupin's indicatrix, principal curvatures, umbilical points, mean curvatures, Gaussian curvatures, geodesic curvatures, Gauss-Bonnet theorem

· MA622 Commutative Algebra 3 credits

Diagrams and exact sequences, Flat modules, Faithfully flat modules, Localization, Prime ideals, Rings and modules of fractions, Local rings, m-adic on Noetherian rings, Primary decomposition

· MA623 Advanced Linear Algebra 3 credits

Vector space, Basis, Linear transformation, Change of basis, Dual spaces, Inner product space, Gram-Schmidt process, Eigenvector, Eigenvalue, Diagonalization of a linear transformation, Complex Vector space, Hermitian and Unitary matrices, Spectral theorem, Jordan canonical form, Generalized eigenvectors, Cayley-Hamilton theorem, Quadratic form, Definite form

· MA624 Numerical Linear Algebra 3 credits

Orthogonality, singular value decomposition, QR-factorization, least square method, conditioning and stability, system of equations, eigenvalues, iterative methods.

- **MA625 Discrete Mathematics 3 credits**
  Logic, set, relation, funtion, Combination, Fibonacci Squence, Recursion, Graph, Tree, Alogithm, Optimization

- **MA626 Algebraic Combinatorics 3 credits**
  Basic enumerations, Poset theory, Generating functions, Free monoids Exponential generating functions, Permutation enumerations of graphs, Partitions, Young tableaux, Symmetric functions, Schur functions, Representation theory.

- **MA627 Number theory 3 credits**
  Algebraic Integers, Dedekind rings, Valuation rings, Completion, ramified-unramified extension, Cyclotomic field, Roots of unity, Discriminant, Norm, Class Field Theory, Kummer Extension.

- **MA628 Cryptology 3 credits**
  Secure communications, Classical Cryptosystem, Basic number theory, Congruence, Modular exponentiation, DES(Data Encryption Standard), RSA Algorithm, Primality testing, Discrete logarithms, Block Cryptography, Knapsack Cryptography

- **MA629 Fuzzy theory 3 credits**
  Introduction to Fuzzy Sets, Crispness, Vagueness, Fuzziness, Uncertainty, Fuzzy Set Theory, Set-Theoretic Operations for Fuzzy Sets, Algebraic Operations, Fuzzy measures, Fuzzy numbers, Fuzzy Relations, Fuzzy Graphs, Fuzzy Control, Fuzzy Data Analysis

- **MA630 Introduction to Mathematics Education 3 credits**
  In this course, we study goal of mathematical problem solving and teaching learning model for mathematical problem solving. We also study some mathematics theories including Dewey's numeric psychology, Thorndike's arithmatic psychology, Skemp's theory of mathematics learning, Van Hiele's theory of mathematics learning level.

- **MA631 Algebraic Number Theory 3 credits**
  Over the field extension, we deal with the following concepts that, the closure of ring of integers integral, factorization of the prime ideal, inertia group, ideal class group, Cyclotomic fields, Minkovski's volume formula, Galois operation on ideals

- **MA632 Differential Geometry I 3 credits**
  In this lecture, we study curves and surfaces in three dimensional space. By defining curves and surfaces as differentiable regular functions, their properties including intrinsic properties under the rigid motion are studied, such as Tangent lines, lengths of curves, curvature, torsion, intrinsic equation and so on. For surfaces, several variable functions are needed and tangent planes, the area of surfaces, curvatures, covariant derivative and I, II fundamental forms

etc. are studied.

- **MA701 Differencial Manifolds 3 credits**
  The implicit function theorem, Differentiable manifolds, Local coordinates, Tangent Vectors and Differentials, Sard's theorem and Regular values, Immersions, Vector fields and flows, Tangent bundles, Tublar neighborhoods and approximations

- **MA702 Homology Theory 3 credits**
  Simplicial homology groups, CW complexes, Singular Homology groups, The Mayer-Vietoris sequence, Cohomology, The Alexander-Poincare duality theorem, The Hurewicz theorem, Kunneth theorem, Universal coefficient theorem

- **MA703 Homotopy Theory 3 credits**
  Cofibrations, H-spaces, Homotopy groups, The homotopy sequence of a pair, Fiber spaces, Free homotopy, The Hurewicz theorem, The Whitehead theorem, Eilenberg-Mac Lane spaces

- **MA704 Probability Differential Equation 3 credits**

- **MA705 Topological Transformation Group 3 credits**
  Transformation groups, Minimal sets, The Enveloping semigroups, Uniform almost periodicity, Distal and Proximal, Bitransformation groups, Universal transformation groups, Point transitive transformation groups

- **MA706 Topics in Topoloy Ⅰ 3 credits**
  Study in current interesting topics in Topology

- **MA707 Topics in Topoloy Ⅱ 3 credits**
  Study in current more interesting topics in Topology

- **MA708 Teaching Materials Research and Teaching Practice in Mathematics 3 credits**

- **MA709 Topics in Differential Geometry 3 credits**
  Study in current interesting topics in Differential Geometry

- **MA710 Group Theory 3 credits**
  Groups, Nilpotent groups, Solvable groups, Representations of groups, Clifford theory, Character theory, Frobenius group, Fitting and Frattini subgroup, Fusion, Transfer and Factor groups

· **MA711 Field Theory 3 credits**

Galois extension, Cyclic extension, Kummer extension, Radical extension, Galois Cohomology, Brauer group of a field, Abelian p-extension, coding Read-Solomon code

· **MA712 Homology Algebra 3 credits**

Hom functor, Tensor functor, Direct limit, Projective module, Injective module, Ext functor, Tor functor, homology, cohomology, group extension.

· **MA713 Group Representation Theory 3 credits**

Group algebra, Character, Clifford Theory, Frobenius group, Brauer's Characterization of Character, Brauer's Splitting Theorem, Projective Representation.

· **MA714 Topics in Algebra Ⅰ 3 credits**

Group, Ring, Field, Module, Representation theory, Algebraic graph theory, Algebraic combinatorics, Cryptology, Coding

· **MA715 Topics in Algebra Ⅱ 3 credits**

Group, Ring, Field, Module, Representation theory, Algebraic graph theory, Algebraic combinatorics, Cryptology, Coding

· **MA716 Topics in Mathematics Ⅰ 3 credits**

Selected topics from mathematics. Content varies from year to year depending on the needs and interests of the students and expertise of the instructor.

· **MA717 Topics in Mathematics Ⅱ 3 credits**

Selected topics from mathematics. Content varies from year to year depending on the needs and interests of the students and expertise of the instructor.

· **MA718 Functional Analysis Ⅱ 3 credits**

The extension principle of Hahn-Banach, Normal solvability, The Baire category principle, The Rieze-Schauder theory of compact operators, The resolvent, The spectrum, Isolated points of the spectrum, Riesz operators, Essential spectra, Orthogonal decomposition in Hilbert spaces, Spectral theory in Hilbert spaces

· **MA719 Probability Theory Ⅱ 3 credits**

Random Walk and Brownian Motion, Discrete-parameter Martov Chair Birth-Death Markov Chains, Continous-Parameter Markov Chains, Brownian Motion and Diffusions, an introduction to stochastic Different Equations

· MA720 Numerical Methods for Different Equations 3 credits
Euler method, Taylor method, Runge-Kutta method, finite difference method, finite element method, collocation method, -Nicolson method, predictor-corrector method

· MA721 Harmonic Analysis 3 credits
Basic definitions and facts, Elements of the theory of topological groups, Integration on locally compact spaces, Invariant functionals, Convolutions and group representations, Characters and duality, Analysis on compact groups

· MA722 Topics in Analysis Ⅰ 3 credits
Study in current interesting topics in Analysis

· MA723 Topics in Analysis Ⅱ 3 credits
Study in current more interesting topics in Analysis

· MA724 Topics in Statistics 3 credits
Study in current interesting topics in Statistics

· MA725 Topics in Probability 3 credits
Study in current interesting topics in Probability

· MA726 Topological Vector Spaces 3 credits
Metric vector spaces, Basic notations from topology, The week topology, The concept of a topological vector spaces, The neighborhood of zero in topological vector spaces, Subspaces, Product spaces, Quotient spaces, Continuous linear maps of topological vector spaces, Finite-dimensional topological vector spaces, Fredholm operators on topological vector spaces

· MA727 Differential Geometry Ⅱ 3 credits
In this lecture, surfaces in three dimensional space and general manifolds are studied. Gaussian and mean curvatures, normal curvature, shape operator, differential forms, the surprising property of the Gaussian curvature and minimal surfaces etc. are covered. Understanding and applying Gauss-Bonnet theorems, we also look at the existence of non-Euclidean geometry. Riemannian manifolds are introduced and many related interesting topics to them are covered.

· Research for the Master's Degree Ⅰ 0 credits
· Research for the Master's Degree Ⅱ 0 credits
· Research for the Doctoral Degree Ⅰ 0 credits
· Research for the Doctoral Degree Ⅱ 0 credits
· Research for the Doctoral DegreeⅢ 0 credits