De La Salle University

DOCTOR OF PHILOSOPHY IN MATHEMATICS

The primary objective of the Ph.D. Mathematics program is to provide training for the development of research capabilities in Mathematics and its possible applications. Complementary to this main objective is the improvement of mathematics teaching in colleges and universities. The program also intends to develop highly trained mathematicians who could address the needs of the other sciences and the industry as well.

Students entering the Ph.D. Mathematics program without a previously earned M.S. degree shall be required to complete at least 66 units of graduate courses while students with a previously earned M.S. degree must complete at least 30 units of coursework.

PROGRAM REQUIREMENTS

Straight PhD Program:

Basic Courses	6 units
Major Courses	30 units
Elective Courses	18 units
Seminar	3 units
Dissertation	12 units
Total	69 units

Regular PhD Program:

Major Courses	12 units
Elective Courses	15 units
Seminar	3 units
Dissertation	12 units
Total	42 units

BASIC COURSES

Set Theory and Logic (MTH601P)
3 units
This course demonstrates the development of mathematical thought through basic logical structures and the concepts of classes and sets, functions, relations, partially ordered classes, axiom of choice and transfinite numbers.

Graduate Seminar in Mathematics (MTH853P)
3 units
A study of the fundamentals of research, preparation of a thesis proposal, thesis writing procedure, mathematical topics for research and a selection of topics on pure and applied mathematics.

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Number Theory (MTH621P)
3 units
A course on the divisibility properties of integers, congruences, diophantine equations, quadratic reciprocity, arithmetic functions and algebraic numbers.

MAJOR COURSES

Abstract Algebra 1 (MTH611P)
3 units
The study of groups, group homomorphisms, Cayley's theorem, Lagrange theorem, permutation groups and Sylow theorems.

Advanced Linear Algebra 1 (MTH613P)
3 units
A course on matrices, vector spaces, linear transformations, eigenvalues, linear functionals, bilinear forms, and quadratic forms.

Advanced Linear Algebra 2 (MTH713P)
3 units
A study of modules, canonical forms, orthogonal and unitary transformations, annihilators, and duality of linear transformations.

Modern Complex Analysis 1 (MTH643P)
3 units
A course on complex numbers and complex lane, Cauchy-Reimann equations, Riemann surface and conformal mappings, infinite series, complex integration, Cauchy integral theory, singularitiesm and residue theory.

Real Analysis 1 (MTH641P)
3 units
A course on calculus on Euclidean spaces, Lebesgue measure and integration, function spaces, and Stone Weierstrass theorem.

Abstract Algebra 2 (MTH711P)
3 units
The second course on abstract algebra which covers rings and ideals, fields, ring homomorphisms, polynomials, fields extension, algebraic and transcendental extensions.

Combinatorial Geometry (MTH665P)
3 units
This course provides an introduction to linear spaces, projective spaces, affine spaces, polar spaces and generalized quadrangles.

General Topology 1 (MTH663P)
3 units
A study of basic topological concepts such as sets, metric spaces, topological spaces, continuous mappings, compactness, connectedness, separability and topological properties.

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Graph Theory (MTH671P)
3 units
A course on graphs, subgraph, trees, factorization, colorings, group graphs and diagraphs.

Real Analysis 2 (MTH741P)
3 units
A study of the generalized measure and integration and topological vector spaces.

ELECTIVE COURSES

Advanced Probability Theory (MTH745P)
3 units
A course on the fundamentals of measure theory, probability space, random variables, expectation, independence, characteristics functions, convergence concepts, conditioning and martingales.

Combinatorial Mathematics (MTH607P)
3 units
An introductory course on combinatorics that deals with selections and binomial coefficients, pairings problems, recurrence relations, the inclusion-exclusion principle, block designs and error correcting codes, Steiner systems, sphere-packing and the Golay code.

Design Theory (MTH683P)
3 units
A study of block designs, symmetric designs, hadammard matrices and designs, latin squares and other designs.

Differential Equations (MTH633P)
3 units
The course deals with systematic development of the theory of first order equations, and the general theory of linear differential equations. This also includes series solutions of second order differential equations and other related topics.

Elementary Probability Theory (MTH605P)
3 units
A course on probability, random variables, moment generating functions, random vectors, special univariate and bivariate distributions.

Enumerative Approaches to Optimization (MTH681P)
3 units
A course on discrete optimization problems, successive conditioning, sequential decision models, dynamic programming, branch-and-bound.

Functional Analysis (MTH645P)
3 units
A course on normed linear spaces, Banach spaces (Hahn-Banach theorem, open mapping theorem, etc.), Halbert spaces, operator theory, spectral theory, and Banach algebras.

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Galois Theory (MTH617P)
3 units
A course on the fundamental theorem of galois theory, fixed fields, galois group, ruler and compass constructions, symmetric rational functions, Zorn's lemma, separability and normality, galois fields and the fundamentals theorem of algebra.

General Topology 2 (MTH763P)
3 units
The second course on topology which includes the concepts of homotopy, fundamentals groups, homology, cohomology and differential manifolds.

Introduction to Mathematical Statistics (MTH603P)
3 units
A course on probability, special parametric families of univariate distributions, joint distribution functions of random variables, sampling and sampling distribution, parametric point estimation, parametric interval estimation and test of hypothesis.

Lattice Theory (MTH687P)
3 units
A study of modular, distributive, brouwerian, and boolean lattices and their applications to algebra and topology, homomorphism and congruence relations.

Linear Programming (MTH619P)
3 units
An introductory course that deals with the mathematics of the simplex method, duality, sensitivity analysis and extension of linear programming.

Modern Complex Analysis 2 (MTH743P)
3 units
A course on entire, harmonic, analytic and meromorphic functions, mobius transformations as well as theorem of Runge, Riemann and Weierstrass.

Multivariate Analysis (MTH695P)
3 units
A study of the analysis of covariance, multivariate analysis of variance, discriminate analysis, factor analysis, cluster analysis, multi-dimensional scaling and reliability analysis.

Numerical Analysis (MTH631P)
3 units
A basic course on numerical solutions of linear systems, non-linear algebraic equations, interpolation and quadratures, ordinary differential equations and eigenvalue problems.

Partial Differential Equations (MTH867P)
3 units
An introduction to the theory of solving partial differential equations, existence/uniqueness of solutions.

Permutation Groups (MTH615P)
3 units
A study of primitive groups, transitive groups, blocks constituents k-transitivity and regular groups k-primitive.

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Regression Analysis (MTH691P)
3 units
A study of simple linear regression and correlation, model validation, multiple regression, variable selection, special linear models, non-linear and non-parametric regression.

Sample Surveys (MTH699P)
3 units
A study of simple random sampling, stratified random sampling, systematic random sampling, systematic and cluster sampling, ratio estimates and cost minimization.

Selected Topics (MTH855P)
3 units
A study of selected topics in specialized areas of mathematics to be chosen by the professor.

Stochastic Processes (MTH609P)
3 units
A course on poisson process, Markov chains, continuous time Markov chains, renewal theory, and martingales.

Time Series (MTH697P)
3 units
A course on linear extrapolation, exponential smoothing, filtering, spectral and cross-spectral analysis, ARIMA and ARIMA processes.

RESEARCH COURSE

Directed Research (MTH921P)
0 units
A research course for students who have finished the course work but not have not taken or passed the comprehensive examination.

DISSERTATION

Dissertation 1 to 15 (MTH976P to MTH987P)
12 units
Conduct of an independent research under the supervision of a dissertation mentor. Students who have already passed the comprehensive examinations are qualified to enroll in this course.

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ENTRY QUALIFICATIONS

- General average of 85%, B, 2.0 or higher.
- For the MS and Straight PhD program: Bachelor's degree in Mathematics or its equivalent.
- For the PhD program: Masteral degree in Mathematics or its equivalent.
- Applicants who do not meet the minimum entry qualification for a graduate program may be advised to take preparatory or refresher courses prior to admission to the program.