Master of Science in Mathematical Sciences
Program code: 041020

INTRODUCTION

The Department of Mathematics offers a graduate program that leads to the degree of Master of Science in **Mathematical Sciences**. The (MMS) program is intended for students who are interested in interdisciplinary program with a major emphasis in mathematics and a minor emphasis in a related subject outside mathematics. The objective of the MMS program is to bridge the gap between mathematics as a discipline and other subjects outside mathematics. The Program features a non-thesis option. The non-thesis option requires the completion of a project, and require a minimum course work and passing a comprehensive examination.

PROGRAM REQUIREMENTS

33 TOTAL COURSE CREDITS

3 COMPULSORY COURSES

0410-593 Project (3)

9-12 BASIC COURSES (3 credits each)

0410-510 Analysis I
0410-512 Complex Analysis I
0410-513 Ordinary Differential Equations
0410-542 Scientific Computing: Mathematical Models and Algorithms

Students must take at least 9 credits from the core courses. If the student chooses to take 12 credit hours from the core courses list, the additional 3 credits will count towards the elective course requirements. The total number of credits of core courses and elective courses must add up to 18 credit hours.

6-9 ELECTIVES* (3 credits each)

0410-501 Algebra
0410-508 Topics in Algebra
0410-515 Functional Analysis
0410-517 Special Functions
0410-520 Boundary value Problems
0410-521 Variational Methods and Eigen value Problems
0410-522 Financial Mathematics Modeling & Computation
0410-523 Topics in Applied Mathematics
0410-525 General Topology
0410-526 Algebraic Topology
0410-531 Differentiable Manifolds
0410-532 Topics in Differential Equations
0410-535 Graphs and Hyper Graphs
0410-537 Combinatorics

0410-543 Advanced Numerical Computing
0410-560 Numerical Solution of ODE's
0410-561 Computational Linear Algebra
0410-568 Topics in Numerical Mathematics

12 MINOR COURSES (non-mathematical courses) (3 credits each)

The student must take 12 credits of non-mathematics courses from an outside area and must be approved by the program director. The outside area can be from any department of the following colleges: Faculty of Science, Faculty of Engineering, Faculty of Medicine, Faculty of Business Administration and Faculty of Education.

COURSE DESCRIPTION

0410-501: ALGEBRA
CR: 3

Fundamental topics on groups including semi groups; Groups; Subgroups; Abelian groups; Direct products; Groups of permutations; Cyclic groups; Normal subgroups; Quotient groups; Homomorphisms and isomorphisms; Group actions; orbits ; Lagrange's Theorem; p-Groups; The Sylow Theorems; The basis Theorem; The fundamental theorem of finite Abelian groups.

0410-508: TOPICS IN ALGEBRA
CR: 3

Topics may differ from time to time, the course may be repeated for credit provided the topics are different.

0410-510: ANALYSIS I
CR: 3

Riemann/ Stieltjes integral; uniform convergence of sequences and series of functions; functions of several real variables; and the Lebesgue integration.

0410-512: COMPLEX ANALYSIS I
CR: 3

Analyticity, Cauchy's integral formula, residues. Infinite products. Conformal mappings. Riemann mapping theorem.

0410-513: ORDINARY DIFFERENTIAL EQUATIONS
CR: 3

Existence and uniqueness of solutions to initial value problems in n-dimensions. Continuation (extendibility) of solutions and continuity with respect to initial conditions and parameters. Stability theory, linearization and Lispunov methods. Sturmian theory and self-adjoint boundary value problems.

0410-515: FUNCTIONAL ANALYSIS
CR: 3

Metric spaces; Normed victor spaces; Inner product spaces; Ip spaces; Topology of a matric space; Complete matric spaces; Banach spaces (Ip and C[a,b]); Hilbert spaces; completion of a matric space (Lp [a,b]); Finite dimensional normed victor spaces; Linear operators; Linear functional; Normed spaces of operators; Dual space; Functional on Hilbert space; Self-ad joint, unitary, and normal operators; Hahn-Banach theorem; Uniform boundedness theorem; Open mapping theorem; Closed graph theorem.

0410-517: SPECIAL FUNCTIONS
CR: 3

Asymptotic expansions. Bessel functions and related functions, hypergeometric, confluent hypergeometric and generalized hypergeometric functions. Jacobi polynomials, Meijer's G-functions.

0410-520: BOUNDARY VALUE PROBLEMS
CR: 3

Partial differential equations of mathematical physics and engineering, the well posed problem, Dirichlet, Neumann and the mixed problems, methods of solution, Green's function, integral equations, integral transforms.

0410-521: VARIATIONAL METHODS AND EIGENVALUE PROBLEMS
CR: 3

Laplace's equation; Fundamental solution, Mean-value property, properties of harmonic functions (max/min principles, harmonic estimates, analyticity, Liouville's Theorem), Green's functions, Dirichlet principle; Weak derivatives; Introduction to Sobolev theory; existence of weak

solutions of various liner elliptic PDEs; Dirichlet principle in Sobolev space, Eigenvalue problems; Introduction to variational principles related to the heat and wave equations.

0410-522: FINANCIAL MATHEMATICS – MODELING & COMPUTATON
CR: 3

The course describes the modeling of financial derivative products, through analysis to elementary computaton. Topics include: basic option theory, tree models, continuous time models and Black-Scholes, analytic approach to Black-Scholes, hedging numerical and binomial methods, bonds and interest rate derivatives models, computational methods for bonds, further theory of exotic and path-dependent options, foreign currency markets and exchange risks.

0410-523: TOPICS IN APPLIED MATHEMATICS
CR: 3

Topics may differ time to time, the course may be repeated for credit whenever the topics are different.

0410-525: GENERAL TOPOLOGY
CR: 3

Abstract topological spaces; connectedness, compactness, continuous functions. Metric spaces, complete metric spaces and metrizable spaces.

0410-526: ALGEBRAIC TOPOLOGY
CR: 3

Fundamental groups, surfaces, and homology theory.

0410-531: DIFFERENTIABLE MANIFOLDS
CR: 3

Manifolds, the topology of manifolds, differentiation on a manifold, vector fields, linear and affine connections, distributions, Riemannian manifolds.

0410-532: TOPICS IN DIFFERENTIAL EQUATIONS
CR: 3

Special topics not covered in other courses. May be repeated for credit under different subtitles.

0410-535: GRAPHS AND HYPER GRAPHS
CR: 3

The path problem, the flow problems,Vizing theorem, the Shannon theorem, chromatic number, chromatic polynomials, perfect graphs, hyper graphs.

0410-537: COMBINATORICS
CR: 3

Different ways of counting, double count, recurrence relations, generating functions, binomial theorem, Inclusion-exclusion principle, Stirling numbers, systems of distinct representatives, combinatorial structures including Latin Squares and designs.

0410-542: SCIENTIFIC COMPUTING: MATHEMATICAL MODELS AND ALGORITHMS
CR: 3

Mathematical modeling using systems of differential equations to model real situations, large systems of linear equations, sparse matrices, pseudo-inverse matrices, multilevel methods, factorization. Ordinary differential equations, initial value problems, one step and multi-step methods for solution, stiff equations, boundary value problems, shooting, difference and variational methods.

0410-543: ADVANCED NUMERICAL COMPUTING
CR: 3

Filling of data, B-spline representations, calculating with B-splines, knote insertion algorithms, curve fitting with splines, surface fitting, mesh data methods, scattered data methods. Transformers and filteration of data, Fourier transformers convolution and correlation, sampling interpolation, deconvolution problem, reconstruction from projections, discrete projections, iterative image reconstruction. Data fitting with fractals, fractal image, fractal dimension, attractor, compression with quadtree, fractal image coding.

0410-560: NUMERICAL SOLUTION OF ODE'S
CR: 3

Concepts of discretization (initial value problems, boundary value problems, integral equations). Difference methods and Galerkin methods. Consistency, stability and convergence. Linear multistep methods, stability theory, spline collocation methods, stiff equations. Two-point boundary value problems, difference methods, shooting techniques, finite elements.

0410-561: COMPUTATIONAL LINEAR ALGEBRA
CR: 3

Basic concepts, Gaussain Elimination and LU-decomposition, QR-Factorization and Lease Square problems, Eigenvalue problems and SVD, Iterative Methods.

0410-568: TOPICS IN NUMERICA MATHEMATICS
CR: 3

Topics may differ time to time, the course may be repeated for credit provided the topics are different.

0410-593: PROJECT
CR: 3

The student undertakes an independent project on a research topic of theoretical and/or experimental focus under the supervision of a faculty member listed in the supervisory list of the College of Graduate Studies. The objective is to provide the student with an opportunity to integrate and apply the knowledge gained throughout the course of study in a practical problem. The student must document the project in a scientific report following standard research writing guidelines and give a public presentation to the project examination committee.