

## **DEPARTMENT OF MATHEMATICS AND STATISTICAL SCIENCES**

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### **Faculty**

Dr. Lecretia A Buckley, Associate Professor  
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Dr. Bassirou Diatta, Associate Professor  
Dr. R. Gentry, Professor  
Dr. Raghu Gompa, Professor  
Dr. Tor A. Kwembe, Professor  
Dr. Mohammad Khadivi, Professor  
Dr. Celestin Wafo Soh, Associate Professor  
Dr. Xing Yang, Assistant Professor  
Dr. Zhenbu Zhang, Associate Professor

The Department of Mathematics and Statistical Sciences in the School of Science and Technology in cooperation with the School of Education offers a program leading to the Master of Science in Teaching (MST) degrees in Mathematics. This department also offers a Master of Science (MS) degree in mathematics for Students who seek careers in college or university teaching, government, industry, business, etc.

### **Program Objectives**

1. To provide quality mathematics training at the master's degree level.
2. To help increase the number of mathematicians qualified to undertake further studies leading to the doctoral degree in the mathematical sciences.
3. To increase the pool of mathematicians seeking to obtain employment in industry, government and academic institutions.

### **Degree Programs**

The M.S. or the M.S.T. degree, in general, can be completed with only course work, a Thesis or Project is optional. However, all of the programs are designed to meet academic requirements for students who are interested in seeking degrees beyond the master's or specialist's level. The M.S.T. degree would lead to a Class "AA" Teaching Certificate for students who hold the Class "A" Teaching Certificate. Students who do not hold the Class "A" Teaching Certificate but wish to receive the M.S.T. degree with a Class "AA" Teaching Certificate must first complete the requirements for a Class "A" Teaching Certificate. A student can also receive the M.S.T. degree without seeking the Class "AA" Teaching Certificate. The coursework requirement for this option is the same with those holding the Class "A" Teaching Certificate.

## **Admissions Requirements**

Admission to a graduate program in mathematics requires at least 15 semester hours of undergraduate mathematics above the regular calculus sequence and the fulfillment of the admission requirement into graduate studies at Jackson State University, which is an earned Bachelor's degree with a cumulative GPA of at least 3.0 on the 4.0 scale in all undergraduate courses taken at a regional accredited degree granting institution. GRE is not required for admission into any of the Master's degree programs. However, students who are seeking to pursue the doctoral degree are encouraged to take the GRE exams, general and subject area, to increase their chances for competitive admission and financial assistance. These exams can be taken while students are taking courses or after they have completed all coursework.

## **Transfer of Credits**

A course for which transfer credit is sought must have been completed with a grade of "B" or better. Departmental approval is required.

## **Time Limit**

Students with adequate mathematics preparation at the undergraduate level will normally take two years to complete any of the Master's degree programs. However, all students must complete their programs within eight years of starting coursework at Jackson State University or elsewhere.

## **Master of Science in Mathematics**

The department offers programs leading to the M.S. degree in Pure or Applied Mathematics for students who plan on pursuing the doctoral degree or wish to seek careers in college or university teaching, government, industry and the business sector. The programs are designed for persons with adequate background in undergraduate mathematics beyond the calculus sequence.

To receive the M.S. degree a student must be in residence at Jackson State University for at least one semester, complete all degree requirements and must take and pass the Graduate English Competency Exam. If a student's GPA upon completion of all coursework is below 3.33, then such a student is required to take and score at least 70% on a comprehensive exit exam given by the Department.

### **The requirements for the M.S. degree are:**

1. Thirty six (36) hours are required with a thesis, i.e. ten (10) courses plus six (6) hours for a thesis, or
2. Thirty six (36) hours are required with a project, i.e. eleven (11) courses plus three (3) hours for a project, or
3. Thirty six (36) hours are required if neither a thesis nor a project is done.
4. A "B" average with no more than one "C" grade is required for graduation, if a student has two "C" grades, then the student must earn an "A" grade in an additional course.

## Required Courses

Course	Title	Hours
Math 513	Modern Linear Algebra I	3
Math 511	Modern Algebra I	3
Math 531	Real Analysis I	3
Math 541	Complex Analysis I	3
Math 551	Introduction to General Topology I	3
Math 561	Probability and Statistics I	3
Math 599	Thesis	6
Total Hours		24

The student will fulfill the remaining 12 hours from mathematics electives drawn from a list of pure or applied mathematics courses to match his/her area of concentration. Courses are offered each semester to match each enrolled student's interest. In consultation with an advisor and the Chairperson of the Department, a student must develop a study plan and select sufficient electives from departmental courses to complete degree requirements with a concentration in either pure or applied mathematics. See the list of departmental courses below. A typical study plan for a student with a concentration in applied mathematics who is seeking to pursue a doctoral degree would look like this:

### Coursework for Year One

Fall Semester

Math 511 - Modern Algebra I

Math 513 – Modern Linear Algebra I

Math 531 - Real Analysis I

Spring Semester

Math 577- Ordinary Differential Equations with Applications

Math 579- Partial Differential Equations with Applications Math

541 - Complex Analysis I

Summer Sessions

Math 599-Thesis

### Coursework for Year Two

Fall Semester

Math 551 – Introduction to General Topology I

Math 542 - Complex Analysis II

Math 532 – Real Analysis II

Math 580 - Partial Differential Equations II or

Math 599 -Thesis

### Extra Coursework and Thesis Defense

Spring Semester

Math 537 - Introduction to Functional Analysis

Math 547- Integral Equations

Take the GRE both General and Subject area tests

Math 599-Thesis

May - Receive the M.S. degree from JSU

## Master of Science in the Teaching of Mathematics

The Department of Mathematics and Statistical Sciences in cooperation with the College of Education and Human Development, the Departments of Biology, Chemistry, and Physics, offers a program leading to the Master of Science in Teaching (M.S.T.) degree with a concentration in biology, chemistry, general science, or mathematics. Based on the certification requirements of the State of Mississippi as stated in Bulletin 130, and upon the stated principles and guidelines of the professional organizations for each content area, the M.S.T. degree program is designed for person with an adequate background in biology, chemistry, general science, or mathematics and who wish additional preparation for teaching or supervision of one of the four aforementioned discipline areas.

### The requirements for the M.S.T. degree are:

1. Thirty six (36) hours are required with a thesis, i.e. ten (10) courses plus six (6) hours for a thesis, or
2. Thirty six (36) hours are required with a project, i.e. eleven (11) courses plus three (3) hours for a project, or
3. Thirty six (36) hours are required if neither a thesis nor a project is done.
4. A "B" average with no more than one "C" grade is required for graduation, if a student has two "C" grades, then the student must earn an "A" grade in an additional course.
5. A maximum of eighteen (18) hours can be counted from education classes.

### Core Educational Courses

Students must choose 4 courses from the following list. Selection of courses is based on the student's intent to obtain a Class "A" certification via the alternate route.

Courses	Title	Hours
EDFL 511	History and Philosophy of Education (R)	3
EDFL 514	Elementary Statistics (R*)	3
EDFL 515	Methods of Educational Research (R)	3
EDFL 581	Principles of Measurement (R**)	3
EDFL 556	Special Topics in Early Childhood/Elementary Education (R**)	3
EDFL 500	Introduction to Teaching Internship(R**)	3
	Total Hours	12

(R) - Required

(R\*) - Required for students without an undergraduate Statistics course and it is a prerequisite for EDFL 515.

(R\*\*)- Required for students seeking Class "A" certification, via the alternate route.

### Required Mathematics Courses

Course	Title	Hours
Math 501	Topics in Geometry	3
Math 506	Basic Concepts for Teachers I	3
Math 510	Topics and Issues in Mathematics	3
Math 513	Linear Algebra I	3
Math 511	Abstract Algebra I	3
Math 531	Real Analysis I	3
	Total Hours	18

Any substitute for the above courses must seek the Department of Mathematics approval.

Students who do not hold the Class "A" Teaching Certificate must also complete the following requirements for certification: Take the PRAXIS I Pre-professional Skills Test (PPST) and make the required cut scores on each of the subtests- reading, writing, and mathematics and successfully complete the PRAXIS 11, mathematics Area Examination. Then complete the following pre-teaching required coursework:

<b>Course</b>	<b>Title</b>	<b>Hours</b>
EDFL 581	Principles of Measurement	3
EDFL 556	Special Topics: Classroom Management	3
EDFL 500	Secondary Internship(R*)	6
	Total Hours	12

(R\*) - Required and a student must be employed and have a GPA of at least 2.5 for all undergraduate course work.

After successful completion of the pre-teaching required coursework, the PRAXIS I and PRAXIS 11, the Mississippi Department of Education Office of Teacher Licensure will issue the applicant upon receipt of PRAXIS test scores, a transcript, a completed application, and institutional recommendation a license that is valid for 5 years.

### **Requirements for Option Choices**

Option 1: Math 590 Thesis 6 (hrs)  
 Option 2: Math 584 Independent Study (Project) 3(hrs), plus 3hr course selected from List I, or  
 Option 3: Six hours selected from List I and three hours selected from List 11 or List 11.  
 Total number of hours for students with Class "A" Teaching Certificate: 36  
 Total number of hours for students without the Class "A" Teaching Certificate: 48

### **List I**

1. Math 503 Foundations of Mathematics 1 (3 hours)
2. Math 504 Foundations of Mathematics 11 (3 hours)
3. Math 512 Modern Algebra 11 (3 hours)
4. Math 514 Modern Linear Algebra 11 (3 hours)
5. Math 532 Real Analysis 11 (3 hours)
6. Math 541 Complex Analysis 1 (3 hours)
7. Math 542 Complex Analysis 11 (3 hours)
8. Math 561 Probability and Statistics 1 (3 hours)
9. Math 562 Probability and Statistics 11 (3 hours)
10. Math 551 Introduction to General Topology 1 (3 hours)
11. Math 552 Introduction to General Topology 11 (3 hours)
12. Math 581 Number Theory 1 (3 hours)

13.Math 582 Number Theory 11 (3 hours)

#### **List II**

14. Math 505 Mathematics for Secondary Teachers (3 hours)

15. Math 506 Mathematics Concepts for Teachers 1 (3 hours)

16. Math 507 Mathematics Concepts for Teachers 11 (3 hours)

17. Math 509 Mathematical Structures (3 hours)

#### **Master's Degree in any of the Education Areas with a Concentration in Mathematics Requirements**

Students in any of the Master's Degree Programs in the College of Education and Human Development who wish to seek a concentration in Mathematics must meet the following requirements:

1. Satisfaction of the admission requirement in the mathematics graduate programs of three advanced mathematics courses beyond the calculus sequence, or completion of an undergraduate degree program at a regionally accredited institution in Elementary or Secondary Education with a concentration in mathematics.
2. Meet the 18 credit hours requirement in Mathematics as follows:
3. 9 credit hours must be taken from the following courses with a cumulative average of at least a "B":  
Math 513 -Linear Algebra 1, Math 511 - Abstract Algebra 1, Math 531 - Real Analysis I or Math 541 -Complex Analysis 1.
4. The remaining 9 hours can be taken in any combination of the graduate level mathematics education courses and the general mathematics courses.

#### **DESCRIPTION OF COURSES**

##### **MATHEMATICS COURSES FOR EDUCATION MAJORS**

**MATH 501 Topics in Geometry.** (3 Hours) Prerequisite: Approval of department. A survey of geometries and their structures. Emphasis is on both synthetic and analytic methods.

**MATH 502 Topics in Algebra.** (3 Hours) Prerequisite: Approval of department. An amalgamation of classical and modern theory, stressing the synthesis of ideas in areas from equation solvability, special algebraic forms (permutations, combinations, arrangements, binomial and multinomial theorems, partial fractions, progressions, groups, rings, domains of integrity, and ideas of interest).

**MATH 503-504 Foundations of Mathematics I-II** (3-3 Hours): The fundamental elements of set theory and finite mathematical structures; cardinals and ordinals; logical deduction, elements of probability; vectors and matrices, linear programming, theory of games and applications.

**MATH 505 Mathematics for Secondary Teachers** (3 Hours): Prerequisite: Approval of department. The basis of the content, philosophy and methodology employed in the teaching of secondary school mathematics is of prime interest here.

**MATH 506-507 Mathematics Concepts for Teachers I-II** (3-3 Hours): Prerequisite: Approval of department. Higher mathematics for teachers, reviewing the fundamental areas of algebra, geometry and analysis, with stress on rigor and validity of ideas.

**MATH 510 Topics and Issues in Mathematics** (3 Hours): This course is designed for in-service teachers who are interested in the renewal of teaching licenses and the pursuit of graduate studies in the teaching of mathematics. Emphasis is on individualized

research dealing with the stages of development of mathematics, new trends in the teaching of mathematics, and the exploration of teaching theories resulting from the work of experimental psychologists such as Piaget, Aushel and Bruner. Because of the individualized nature of the course, students with diverse backgrounds in mathematics can be accommodated.

## **COURSES FOR ALL GRADUATE MATHEMATICS MAJORS**

**MATH 511-512 Modern Algebra I-II** (3-3 Hours) Groups, (homomorphisms), rings, integral domains, modules and fields, elementary linear algebra, number theory.

**MATH 513-514 Modern Linear Algebra I-II** (3-3 Hours) Vector spaces, matrices, linear transformations, determinants and linear equations. Selected topics on eigenvalues, canonical forms, inner products, inner product spaces, bilinear and quadratic forms.

**MATH 515-516 Advanced Modern Algebra III-IV** (3-3 Hours) Prerequisite: Mathematics 512. Special topics in groups, rings and fields, factorization theory, extensions of rings and fields, modules, elementary theory of fields.

**MATH 521-522 Modern Geometry I-II (3-3 Hours):** Prerequisite: Mathematics 511, concurrent enrollment or approval of department. Historical development; sets and projective planes and geometries; vectors, transformations, axiomatic affine, projective and plane geometry.

**MATH 523-524 Modern Geometry III-IV** (3-3 Hours) Prerequisite: Mathematics 523 or approval of department. Motions and transformations, projective and topological transformations, projective plane, analytic projective geometry; absolute, ordered, affine and hyperbolic geometries; elementary differential geometry, topology of surfaces.

**MATH 525-526 Introduction to Differential Geometry I-II** (3-3 Hours): Prerequisite: Mathematics 523 or approval of department. Curves and surfaces in three dimensions by classical methods, introduction to corresponding problems in n-dimensions involving tensor methods.

**MATH 527-528 Projective Geometry I-II.** (3-3 Hours) Prerequisite: Mathematics 512 or approval of department. The projective plane, polarities and conic sections, affine geometry, projective metrics, non- Euclidean Geometry, spatial geometry.

**MATH 529-530 Systems Analysis I-II.** (3-3 Hours) Prerequisite: Approval of department. An analysis of the numerical and abstract systems of mensuration. Stress is placed on the metric and English systems, conversion analysis and other systems of interest.

**MATH 531-532 Real Analysis I-II.** (3-3 Hours) Prerequisite: Math 511 or approval of department. Metric spaces, regulated functions and integrals; integrals of Riemann and Lebesgue; trigonometrical and Fourier series; differentiation and Stieltjes Integrals.

**MATH 533-534 Advanced Analysis I-II.** (3-3 Hours) Prerequisite: Mathematics 532 or approval of department. Further treatment of limits, continuity, differentiability and integrability of functions of one and more variables. Infinite series and products, power and trigonometric series; selected topics.

**MATH 535-536 Introduction to Measure and Integration I-II.** (3-3 Hours) Prerequisite: Mathematics 531 or approval of department. Lebesgue measure of linear sets, measurable functions, definite integral, convergence, integration and differentiation, spaces of functions, orthogonal expansions, multiple integrals and the Stieltjes Integral.

**MATH 537-538 Introduction to Functional Analysis I-II.** (3-3 Hours) Prerequisites: Mathematics 512, 531, or approval of department. Fundamentals of the theory of vector spaces; Banach spaces; Hilbert spaces. Linear functionals and operators in such spaces; spectral resolution of operators, applications.

**MATH 539-540 Introduction to Infinite Series I-II.** (3-3 Hours) Prerequisites: Mathematics 511 and approval of department. Complex numbers, sets and functions; limits and continuity; analytic functions of a complex variable, elementary functions; integration; power and Laurent series, calculus of residues, conformal representation, special topics.

**MATH 541-542 Complex Analysis I-II.** (3-3 Hours) Complex numbers, sets and functions; limits and continuity; analytic functions of a complex variable, elementary functions; integration; power and Laurent series, calculus of residues, conformal representation, special topics.

**MATH 544 Introduction to Entire Functions.** (3 Hours) Prerequisite: Mathematics 541. Entire functions, maximum absolute value and order, zeroes of entire functions, fundamental theorem of algebra, Picard's Little Theorem, algebraic relationships and addition theorem; special theorems and functions.

**MATH 545 Laplace Transforms.** (3 Hours) Prerequisites: Math 534 and approval of department. The Stieltjes Integral; fundamental formulae; moment problem, Tauberian theorems, bilateral Laplace Transform, inversion and representation problems, the Stieltjes Transform.

**MATH 546 Special Functions.** (3 Hours)

Prerequisites: Math 535 and approval of department. Infinite products, Gamma and Beta functions, series, polynomials, functions, relations and sets of analysis and differential equations.

**MATH 547-548 Integral Equations I-II.** (3-3 Hours) Prerequisites: Math 534, 542, and approval of department. Theory of Fredholm and Volterra equations; Hilbert-Schmidt theory; singular integral equations and some applications.

**MATH 549-550 Methods In Applied Mathematics I-II.** (3-3 Hours) Prerequisite: Approval of department. Elements of linear algebra; applications to systems of linear variables; function spaces; tensor analysis, applications to geometry, electromagnetic theory, Lagrangian and Hamiltonian formulations of mechanics; other topics of interest.

**MATH 551-552 Introduction to General Topology I-II. (3-3 Hours)** Prerequisites: Mathematics 223 and approval of department. Elementary set theory, ordinals and cardinals; topological spaces; cartesian products; connectedness; special topologies; separation axioms; covering axioms, metric spaces; convergence; compactness; function spaces; spaces of continuous functions and complete spaces; homotopy; maps into spheres; topology of  $E_n$ ; homotopy type; introduction to algebraic topological ideas.

**MATH 553-554 Introductory Algebraic Topology I-II.** (3-3 Hours) Prerequisites: Mathematics 552 and approval of department. Complexes, simplicial, singular and Čech Homology Theory. Homotopy groups and basic theorems of algebraic topology.

**MATH 555-556 Introduction to Combinatorial Topology I-II.** (3-3 Hours) Prerequisites: Mathematics 553 and approval of department. Properties of topological spaces; Jordan's theorem, surfaces, complexes, coverings, dimension; the Betti Groups, homology theory, manifolds, the duality theorems, cohomology groups of compacta, introduction to theory of continuous mappings of polyhedra.

**MATH 557-558 Introduction to Algebraic Geometry I-II.** (3-3 Hours) Prerequisites: Mathematics 512, 521, or approval of the department. Algebraic preliminaries, local rings valuation theory, power series, rings, geometry of algebraic varieties with emphasis on curves and surfaces.

**MATH 559-560 Linear Programming I-II.** (3-3 Hours) Basic Concepts, graph theory, theory of games, Markov Chains, Leontief Economic Models, Optimizing linear functions of variables subject to constraints, a geometric approach, simplex method, convex sets duality, applications.

**MATH 561-562 Probability and Statistics I-II.** (3-3 Hours) Prerequisite: Mathematics 532 or approval of department. Basic concepts of measure theory and integration axiomatic foundations of probability theory, distribution functions and characteristics functions, central limit problem, modern statistical inference, analysis, variance, decision functions.

**MATH 563-573 Design I-II.** (3-3 Hours) Prerequisite: Mathematics 272. Experimental Design: Completely randomized design; randomized block designs, factorial experiments split plot design. confounding.

**MATH 564 Linear Models.** (3 Hours) Prerequisite: Mathematics 562 or departmental approval. Linear statistical models, some noise-reducing experimental designs, an example of a volume-increasing design, fitting the general linear model, inference making, multi parameter hypothesis: the analysis of variance, the effect of coding on the analysis, seeking a maximum or minimum response, fractional factorial experiments and incomplete block designs, an example of a completely random model, mixed models.

**MATH 565 Multivariate Analysis.** (3 Hours) Prerequisites: Mathematics 562 and approval of department. General linear hypothesis; least square estimation; confidence regions, multiple comparison; analysis of complete layouts; effects of departures from underlying assumptions. Analysis of covariance.

**MATH 566-566W Operations Research.** (3-3 Hours) Prerequisite: Math 232, 355. Linear programming,



network analysis, PERT-CPM, dynamic programming, queuing theory and decision analysis.

**MATH 567-568 Nonparametric Statistics I-II.** (3-3 Hours) Prerequisites: Mathematics 562 and approval of department. Problems of estimating testing hypotheses when the functional form of the underlying distribution is unknown. Robust methods; sign test, rank test and confidence procedures based on these tests; tests based on permutations of observations. Non-parametric tolerance limits; large sample properties of the tests, multi sample problems; ranking methods in analysis of variance; Bivariate and multivariate procedures, efficiency comparisons.

**MATH 569-570 Functions of Several Real Variables I-II.** (3-3 Hours) Prerequisites: Mathematics 533 and approval of department. Euclidean spaces, Mapping and differentials, manifolds, differential forms, vector analysis.

**MATH 571-572 Numerical Analysis I-II.** (3-3 Hours) Prerequisite: Approval of department. Introduction to Matlab, approximate differentiation, local truncation error and order, Euler's method, Runge-Kutta methods, embedded Runge-Kutta methods, stiff equations and implicit methods, explicit multi-step methods, implicit multi-step methods, shooting method, finite element method, finite difference methods for partial differential equations.

**MATH 573 Fractal Geometry.** (3 Hours) Prerequisite: Math 511 or departmental approval. Metric spaces, equivalent spaces, classification of subsets, and the Space of Fractals. Transformations on metric spaces, contraction mappings, and the Construction of Fractals. Chaotic Dynamics of Fractals, Fractal Dimension. Fractal Interpolation. Julia Sets. Parameter Spaces and Mandelbort Sets. Measures on Fractals.

**MATH 574 Numerical Linear Algebra.** (3 Hours) Prerequisite: Approval of department. Elementary numerical analysis; matrix algebra; elimination and compact elimination methods; orthogonalization methods; condition, accuracy, and precision; comparison of methods; iterative and gradient methods; iterative and transformation methods for latent roots and vectors; error analysis for latent roots and vectors.

**MATH 575-576 Approximation and Interpolation I-II.** (3-3 Hours) Prerequisite: Approval of department. Interpolation, remainder theory; convergence theorems; infinite interpolation; uniform approximation; best approximation; least squares approximation; Hilbert space; orthogonal polynomials; closure and completeness.

**MATH 577-578 Ordinary Differential Equation I-II.** (3-3 Hours) Ordinary differential equations: basic theorems of existence, uniqueness, and continuous dependence of the solutions; linear differential equations and systems; stability theory; topology of integral curves; differential equations in the complex domain, asymptotic integration; boundary value problems. Partial differential equations; equations of first order method of characteristics, Hamilton-Jacobi theory; equations of second order-classification according to type; elliptic equations-potential equation, maximum principle, characteristics, and other topics of interest.

**MATH 579-580 Partial Differential Equations I-II. (3-3 Hours)** Prerequisite: Mathematics 577 or departmental approval. Linear equations with constant coefficients in two independent variables, applications, eigenfunction expansions, homogeneous and nonhomogeneous equations. Fourier series, existence, solution uniqueness and representation, Initial boundary value problems, Laplace's equation, and special topics.

**MATH 581-582 Number Theory I-II.** (3-3 Hours) Prerequisites: Approval of department. Diophantine analysis, primes, residue classes, theorems of Euler, Fermat, and Wilson, Continued Fractions, Chinese Remainder Theorem, quadratic reciprocity, valuations, extensions of valuations, local and global fields, discriminant.

**MATH 583 Advanced Number Theory.** (3 Hours) Prerequisite: Mathematics 581 or departmental approval. Quadratic and Cyclotomic extensions, elementary class field theory, and selected topics.

**MATH 584 Independent Study.** (3 Hours) Prerequisite: Departmental consent. Intensive study and research of a subject selected in accordance with student needs and arranged in consultation with the staff. Topics will vary. Student will make periodic reports on his/her reading and will-prepare a scholarly paper on a problem.

**MATH 588-589 Sampling Methods I-II.** (3-3 Hours) Prerequisite: Mathematics 272. Sampling methods: Simple random sampling, sampling for proportions and percentages, estimation of sample size, stratified random sampling ratio estimates.

**MATH 590 Thesis.** (3 Hours) The candidate for the Master of Science in Teaching degree must present a Thesis embodying the results of her/his research. The candidate chooses her/his problem, but approval by her/his adviser is required.

**MATH 599 Thesis.** (3 Hours) The candidate for the Master of Science degree must present a Thesis embodying the results of her/his research. The candidate chooses her/his problem, but approval by her/his adviser is required.