

**LBS875, LBS876 Directed Study Media Specialists****3 Credits**

An independent research project supervised by a member of the Library Science Faculty.

LBS900N Practicum Experience for Library**3 Credits**

The Practicum experience consists of 150 hours of supervised experience in a school library media center. This practical experience allows the students to demonstrate his or her knowledge of the various professional competencies required of the library media specialists.

LBS903 Materials Selection in Children's Fiction**3 Credits**

Students will explore the range and types of children's books (K-6) including folklore, realistic fiction, fantasy, picture books and poetry. Within each type, books will be examined to establish criteria for their election and use. Students will become familiar with standard library aids for selection. Availability and use of related media in school literature and library programs will also be considered.

LBS905 Clinical Experience for Library Media Specialists**6 Credits**

The clinical experience leads to full certification as a library media specialist in Massachusetts. This supervised experience involves a total of 400 hours and includes observation and participation in all aspects of the school library media center. The student will have an opportunity to demonstrate professional competencies for meeting the required state standards in practical setting.

LBS980 Advance Reference**3 Credits**

Designed to complement and build on LBS710 which is a prerequisite. Business and legal references are among subjects covered. Each student is responsible for a research paper and a bibliographic instruction presentation. Other weekly exercises include hands-on experience with electronic resources including Internet.

Mathematics

MAT701 Vector and Tensor Analysis**3 Credits**

Suggested topics are: Definition of vectors and transformation equations, general Cartesian co-ordinates; vector and scalar products, geometry of space curves; introduction to differential forms and tensors.

MAT702N Research on Teaching Methods in Mathematics I**3 Credits**

Prerequisites: Completed course in statistics and completion of the Measurement and Evaluation standard

This course will allow the student to find and study models of accomplished researchers on the teaching of Mathematics at the secondary level. The course will examine necessary concepts in research validity; data gathering; instrumentation selection and construction; validation and reliability determinations; sampling techniques; and, research designing. Further, the course will review the application of statistical models salient to designs utilized in conducting research which requires the testing of hypotheses that have been generated from problems in secondary Mathematics. Open only to MAT and M.Ed. candidates for degree credit.



MAT703 Research on Teaching Methods in Mathematics II

3 Credits

Prerequisite: MAT702N

This course is an extension of MAT702N and will build upon the competencies and skills obtained in that Research Methods I course. Students will further develop their abilities to find and analyze contemporary research in the teaching of secondary school Mathematics. Again, both qualitative and quantitative research will be emphasized. In this second course in Research Methods, students will be paying special attention to hypotheses, designs, statistical models and data gathering techniques of published research for the special purpose of designing their own research projects on topics germane to the teaching of secondary school Mathematics. Class instruction will also emphasize guidelines for such research designing. Open only to MAT and M.Ed. candidates for degree credit.

MAT704 Linear Algebra

3 Credits

Prerequisites: 6 hours of calculus and 3 hours of linear algebra

Topics include modules, linear dependence, matrix algebra, linear transformations, determinants, eigenvalues, linear systems, inner products, classical groups, diagonalization, symmetric matrices, function spaces, and differential operators.

MAT705 Modern Plane Geometry

3 Credits

Prerequisite: Two semesters of calculus

Suggested topics are: axiomatic approach to plane geometry, parallel postulate, Euclidean and hyperbolic geometries; quadratic extensions and angle trisection; plane measure.

MAT706 Theory of Numbers

3 Credits

Prerequisite: Permission of the Department Chairperson

Suggested topics are: properties of divisibility, linear congruences; quadratic congruences; prime numbers, continued fractions; number-theoretic functions; primitive roots and quadratic residues.

MAT707 Mathematical Statistics

3 Credits

Prerequisite: 12 hours of calculus

A calculus-based study of probability and statistics. Topics include probability models, discrete and continuous random variables and their distributions, bivariate and multivariate distributions, sampling distributions, limit theorems, point and interval estimation, theory and applications of hypothesis testing, linear regression and correlation.

MAT708 Introduction to Cryptography

3 Credits

Prerequisite: Mathematical maturity as demonstrated by any one of the following- at least 12 credits of undergraduate or graduate math courses, or a score of 700 or higher on the math SAT or GRE

The study of methods of sending messages in disguised form, including some recent applications of number theory and group theory to public key cryptography. Topics include elementary number theory, finite fields, group theory, cryptosystems, and public key cryptography.

**MAT709 Complex Variables****3 Credits**

Prerequisite: Real Analysis I or the equivalent

Complex numbers, analytic functions, derivatives and integrals of complex functions, Cauchy integral theorem and formula, Taylor and Laurent series, residues, maximum principles, conformal mapping, families of analytic functions and analytic continuation.

MAT710 Foundations of Mathematics**3 Credits**

Suggested topics are: propositional and predicate calculi, consistency and completeness of axiom systems, Godel's theorem, axiomatic set theory, cardinal and ordinal numbers.

MAT711 Real Analysis I**3 Credits**

Prerequisite: 12 hours of calculus or the equivalent

Completeness, limits, continuity, convergence of sequences and series, derivatives, the Riemann integral, and theorems of Taylor, Bolzano-Weierstrass, and Heine-Borel together with applications.

MAT712 Topology I**3 Credits**

Prerequisite: Real Analysis I or the equivalent

Topics in analytic, geometric and combinatorial topology, with an emphasis on specific examples. Concepts covered include continuity, separation, compactness, connectedness, matrix spaces and the fundamental group.

MAT713 Ordinary Differential Equations**3 Credits**

Prerequisites: 9 hours of calculus

Suggested topics are solutions of linear differential equations and systems of equations. Bessel and Legendre functions, Laplace transforms, series solutions, Sturm-Liouville theory, stability theory and singular points.

MAT714 Algebraic Structures**3 Credits**

Prerequisites: 3 hours of modern algebra or abstract algebra

The basic properties of groups, rings, integral domains and fields are quickly reviewed. A theoretical treatment of specific structures such as permutation groups, the ring of integers, polynomial rings, modular systems, and algebraic number fields is given.

MAT715 Topics in Modern Geometry**3 Credits**

Suggested topics are: homogeneous co-ordinates, cross ratio, quadratic involution on a line, fixed points, binary forms, binary quadratic forms, Jacobians, Hessians, Pluckerian line co-ordinates, cross ratio of a line pencil, poles and polars, conic as defined by Steiner, pencils of conics, tensors, measure in the plane, elliptic and hyperbolic geometry.

MAT716 Analytic Number Theory**3 Credits**

Prerequisites: Theory of Numbers and Complex Variables

Suggested topics are: Riemann zeta function, prime number theorem, L-functions, Dirichlet's theorem, Waring's problem, partitions, Goldbach's conjecture.



MAT721 Real Analysis II

3 Credits

Prerequisite: Real Analysis I

Suggested topics are functions of several real variables, Jacobians, implicit and inverse function theorems, vector analysis, theorems of Green, Gauss, and Stokes, with applications and additional topics as time permits.

MAT723 Numerical Analysis

3 Credits

Prerequisite: Ordinary Differential Equations

Suggested topics are least-square polynomial approximation, numerical integration, rootfinding, numerical solution of differential equations, direct and iterative methods in matrix theory, analysis of numerical stability.

MAT724 Abstract Algebra

3 Credits

Prerequisite: Linear Algebra

Suggested topics are: Sylow theorems, Jordan-Holder theorem, algebraic and transcendental field extensions, Galois theory, solvability of polynomial equations, ideal theory, modules.

MAT725 Fractal Geometry

3 Credits

Prerequisite: Acceptance into either the Master of Science in Mathematics, Master of Arts in Teaching Mathematics or the Master of Science in Geo-Information Science program or permission of the Mathematics Graduate Program Coordinator

A study of the geometry of fractal sets, self-similarity and fractal dimension. Suggested topics are: Iteration using the computer, graphical analysis, the Julia and Mandelbrot sets, chaos and applications to image compression, to dynamical systems and to computing the limiting perimeter and area enclosed by fractal sets.

MAT731 Measure and Integration

3 Credits

Prerequisite: Real Analysis I or the equivalent

Suggested topics are: metric spaces, topological spaces, abstract measure; outer measure, absolute continuity, measure spaces, measurable functions, Lebesgue-Stieltjes integration, product measure, Caratheodory outer measure, L-spaces, the Radon-Nikodym theorem.

MAT734 Linear and Multilinear Algebra

3 Credits

Prerequisite: Linear Algebra

Suggested topics are: canonical forms for matrices and linear transformations, quadratic forms, principal axis theorem, tensor products, exterior and symmetric algebras.

MAT737 Operations Research

3 Credits

Prerequisite: 6 hours of calculus

The objective of this course is to teach students to design, solve, and apply operations research models to the analysis of systems problems in industry, business, or government. Suggested topics are linear programming, network analysis, dynamic programming, integer programming, nonlinear programming, queueing theory and inventory.

MAT/CSC740 Computer Applications in Mathematics I

3 Credits

The FORTRAN language is introduced and used to illustrate computer methods in Calculus, Number Theory, Algebra, Statistics and Economics. Attention is paid to machine accuracy, error estimation and multiple-precision arithmetic. Assignments include the coding and running of programs in the Computer Laboratory. No previous computer experience required.

**MAT/CSC741 Computer Applications in Mathematics II****3 Credits**

Prerequisite: MAT/CSC740

Continuation of MAT/CSC740. Further techniques of FORTRAN programming are discussed, with applications to transcendental equations, interpolation, optimization, modeling, simulation, and Physical Science.

MAT747 Applied Statistical Inference**3 Credits**

Prerequisite: Acceptance into either the Master of Science in Mathematics, Master of Arts in Teaching Mathematics or the Master of Science in Geo-Information Science program or permission of the Mathematics Graduate Program Coordinator

A study of probability and statistical inference. Suggested topics are: Probability, discrete and continuous probability distributions, sampling distribution theory, confidence intervals, tests of statistical hypotheses, linear regression, and a nonparametric method: the Kolmogorov-Smirnov Goodness-of-Fit Test; applications to spatial statistics. The emphasis of the course is on applications and conceptual understanding, rather than on mathematical derivations.

MAT750 History of Mathematics**3 Credits**

Prerequisite: 9 Hours of Calculus

A survey course designed to deepen the student's knowledge of the vast literature of mathematics. Historically influential concepts will be examined for their effects on mathematics and the culture in which they evolved. Philosophical and psychological comparisons will be made between the mathematical and scientific developments in Ancient Greek times, in the Renaissance and Newtonian times, and in the 19th and 20th centuries.

MAT801 Differential Geometry**3 Credits**

Prerequisite: Vector and Tensor Analysis

Suggested topics are: curves, vectors, curvature, hypersurfaces in R^3 , the sphere map and the Weingarten map, lines of curvature, tensors and forms, Gaussian curvatures, theorems on surfaces in the large, intrinsic geometry, connexions, geodesics, Gauss-Bonnet formula.

MAT804 Advanced Topics in Algebra**3 Credits**

Prerequisite: Abstract Algebra

Suggested topics are: Module and ideal theory, Noetherian rings, local rings, structure of rings, introduction to categorical algebra.

MAT807 Statistical Inference**3 Credits**

Prerequisite: Mathematical Statistics

A continuation of MAT707. Suggested topics are multiple regression, analysis of variance, decision functions, Bayes solutions, and nonparametric methods.

MAT809 Theory of Functions of a Complex Variable**3 Credits**

Prerequisite: Complex Variables

Suggested topics are: conformal mapping, Riemann mapping theorem, harmonic functions, Riemann surfaces, theorems of Weierstrass and Mittag Leffler, infinite products, entire functions.



MAT812 Topology II **3 Credits**

Prerequisite: Topology I or the equivalent

Suggested topics are: product topologies, Tychonoff's theorem, paracompactness, metrization theorems, uniform spaces, topological groups.

MAT813 Partial Differential Equations and Fourier Series **3 Credits**

Prerequisite: Ordinary Differential Equations

Suggested topics are: wave equations, elliptic and parabolic equations; Fourier series; Sturm-Liouville theory and general Fourier expansions; eigenvalue expansions and Bessel functions.

MAT816 Algebraic Number Theory **3 Credits**

Prerequisite: Abstract Algebra

Suggested topics are: algebraic number fields, ideal theory in rings of algebraic integers, finiteness of class number, Dirichlet unit theorem, zeta functions.

MAT821 Functional Analysis **3 Credits**

Prerequisite: Measure and Integration

Suggested topics are: metric spaces, topological linear spaces, general theory of linear operators, spectral analysis of linear operators, spectral analysis in Hilbert space, the Stone-Weierstrass Theorem, introduction to Banach spaces, Hahn-Banach Theorem.

MAT822 Introduction to Algebraic Topology **3 Credits**

Prerequisites: Topology I, Abstract Algebra

Suggested topics are: homotopy theory (fundamental group, covering spaces), simplicial complexes, singular homology theory, products and Kunneth theorems.

MAT831 Manifolds and Differential Forms **3 Credits**

Suggested topics are: differential manifolds, differential forms, connexions; Riemannian manifolds; operators on forms and integrations; Gauss-Bonnet formula and theory of rigidity; Pfaffian forms; Lie groups; DeRham's Theorem.

MAT900 Seminar: Independent Study **3 Credits**

Open only for graduate students seeking the degree of M.Ed. in Elementary Education with a specialization in mathematics.

MAT910 Seminar in Mathematics **3 Credits**

Intended primarily for graduate students seeking the degree of Master of Arts in Teaching Mathematics. The seminar will explore various topics in mathematics on an individual and group basis.

MAT920 Seminar and Workshop in Teaching Mathematics **3 Credits**

Intended primarily for graduate students seeking the degree of Master of Arts in Teaching Mathematics).The purpose of this course is to explore applications of mathematical topics to the teaching of mathematics on the junior high and high school levels.

MAT930 Seminar: Independent Study **3 Credits**

Open only to students seeking the degree of Master of Science.

**MSM701 Patterns, Relations, and Algebra for Middle School Teachers 3 Credits**

Prerequisites: Acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

Topics include the expression of approximate relationships in data using tables and graphs, linear, polynomial, and exponential relationships, sequences, especially recursive sequences. The course emphasizes multiple approaches to analyzing mathematical relationships (e.g. graphical, tabular, algebraic, numerical, etc.) and will develop a facility with manipulating the mathematical symbolism.

MSM703 Precalculus for Middle School Teachers 3 Credits

Prerequisites: MSM701 and acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

This course is intended to bridge the gap between algebra and calculus. It will develop a firm understanding of the concept of function, how to graphically represent various functions, analyze their behavior and create new functions from old. The course will look closely at various function classes including polynomials, exponential, logarithmic and trigonometric. Functions will be used to model real-life situations.

MSM705 Geometry and Measurement for Middle School Teachers 3 Credits

Prerequisites: Acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

A comprehensive coverage of measurement concepts including perimeter, area, surface area volume, and the Pythagorean theorem. Topics include properties of plane and 3-dimensional geometric figures, the concepts of congruence, similarity, symmetry, transformations and tessellations. An understanding of the nature and techniques of establishing geometric proofs is also central to the course.

MSM707 Number Systems for Middle School Teachers 3 Credits

Prerequisites: Acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

This course gives the middle-school teacher a deeper understanding of number systems (integers, rational numbers, real numbers, complex numbers). Topics include divisibility, factorization, Fundamental Theorem of Arithmetic, equivalence relations, congruence, Chinese Remainder Theorem, decimal representation, axioms for number systems, and geometric representation of numbers.

MSM709 Data, Statistics and Probability for Middle School Teachers 3 Credits

Prerequisites: Acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

Teachers are introduced to methods of graphically displaying, collecting and analyzing data. Techniques involved in computing probability and counting principles will also be introduced. Topics will include measures of central tendency and dispersion, histograms, stem-leaf graphs, box plots, binomial probabilities, normally distributed variables, as well as linear and non-linear regression.



MSM711 Linear Systems for Middle School Teachers

3 Credits

Prerequisites: MSM701 and acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

This course gives the middle-school teacher a deeper understanding of systems of linear equations and matrices. Topics include operations on matrices, solving linear systems, inverses and determinants of matrices, and applications of matrices. Particular emphasis will be placed on using matrices in transformational geometry.

MSM713 Calculus for Middle School Teachers

3 Credits

Prerequisites: MSM703 and acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

This course will provide teachers with a conceptual basis for understanding how calculus provides a powerful tool for analyzing change in our world. Topics include limits, slopes and tangent lines, differentiation rules, the chain rule, approximations, Newton's method, extreme values and curve sketching, an introduction to integration with applications to area between curves, the Fundamental theorems of Integral Calculus and the basic integration techniques.

MSM715 Discrete Mathematics for Middle School Teachers

3 Credits

Prerequisites: MSM701 and acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

This course gives the middle-school teacher a deeper understanding of topics from discrete mathematics taught in middle school. These include combinatorics, graph theory, trees, networks, Pascal's triangle, the binomial theorem, sequences, set theory and recursion. Students will study logic and methods of proof in order to construct their own proofs. Problem-solving heuristics will also be discussed.

MSM717 History of Mathematics for Middle School Teachers

3 Credits

Prerequisites: Acceptance into the Master of Arts in Teaching Middle School Mathematics program or permission of the program coordinator. Not available for degree credit towards the MAT or MS mathematics programs.

This course is a survey of the history of mathematics, with emphasis placed on the development of topics encountered by students in elementary through middle school. Topics include numeration systems of ancient cultures, Euclidean geometry and number theory, origins of algebra, calculating devices throughout history, mathematics of non-western cultures, classical probability and modern topics such as graph theory and fractals.

Music

MUS700 Music Listening in the Classroom

3 Credits

In this course, students will explore specific teaching techniques for listening to and hearing music. Recent research will be explored showing that learning music may be an effective tool for learning other subjects. The techniques are applicable to all levels, but the specific music and learnings will vary.