

## MATHEMATICAL SCIENCES

*Professors:* W. P. Adams, J. R. Brannan, N. J. Calkin, C. L. Cox, V. J. Ervin, X. Gao, R. E. Jamison, P. C. Kiessler, K. B. Kulasekera, R. B. Lund, W. F. Moss III, D. R. Shier, R. L. Taylor, *Chair;* D. D. Warner, M. M. Wiecek; *Associate Professors:* C. M. Gallagher, S. L. Ganter, K. L. James, E. W. Jenkins, T. R. Khan, H. K. Lee, H. Maharaj, G. L. Matthews, C. Park, J. K. Peterson, M. J. Saltzman, C. L. Williams; *Assistant Professors:* D. M. Ambrose, J. Brown, E. S. Dimitrova, B. H. Fralix, J. A. Hoffacker, H. Kerivin, M. Macauley, H. R. MacMillan, M. J. Schmoll, H. Maharaj, J. Medlock, L. Rebholz, S. Sun, X. Sun, F. X. Vera, H. Xue, J. R. Yoon; *Senior Lecturers:* S. S. Biggers, M. E. Cawood, T. A. Johnson, S. A. Prevost, D. M. Simms; *Lecturers:* J. E. Cottingham, R. E. Davidson, C. A. Davis, E. Gallagher, A. A. Guest, M. L. Hanna Jr., L. A. Kinard, M. Z. Krohn, J. M. Lamb, J. I. McKnew, D. A. Moss, J. R. Newton, T. F. Parrott, M. A. Reba, M. Rios-Adams, L. J. Shick, W. B. Staufeneger, A. K. Stoddard, T. C. Teitloff, J. Van Dyken, S. E. Walker; *Visiting Professors:* J. D. Fulton, W. J. Padgett; *Visiting Associate Professor:* D. M. Fairbairn; *Visiting Assistant Professors:* E. H. Breazel, M. Z. Krohn, J. B. Lassiter, B. A. Novick, I. V. Viktorova

**MTHSC 101 Essential Mathematics for the Informed Society 3(3,0)** Topics include logic and computers, probability and statistics, and financial mathematics. Specific topics include Boolean algebra, digital data formats, randomness, graphical representation of data, inference and estimation; interest, annuities, and amortization. Not open to students who have received credit for MTHSC 301, 302, 309, or EX ST 301. *Preq:* Satisfactory score on the Clemson Mathematics Placement Test or consent of department.

**MTHSC 102 Introduction to Mathematical Analysis 3(3,0)** Intuitive approach to the concepts and applications of calculus. Topics include functions and graphing, differentiation, and integration. Applications from social, biological, and management sciences are presented. Not open to students who have received credit for MTHSC 106. *Preq:* Satisfactory score on the Clemson Mathematics Placement Test or consent of department.

**MTHSC 103 Elementary Functions 3(2,2)** Gateway course for MTHSC 106. Comprehensive treatment of functions and analytic geometry with applications including polynomial, rational, algebraic, exponential, logarithmic, and trigonometric functions. Not open to students who have received credit for MTHSC 105. To be taken Pass/Fail only. *Preq:* MTHSC 104 or satisfactory score on the Clemson Mathematics Placement Test.

**MTHSC 104 Precalculus and Introductory Differential Calculus 4(4,0)** Relevant precalculus and algebra review, limits, continuity, and introduction to differential calculus. The combination of MTHSC 104 and MTHSC 107 covers the same calculus material as MTHSC 106. MTHSC 104 alone cannot be substituted for any calculus course. Pass/Fail only. Not open to students who have received credit for MTHSC 106.

*Preq:* MTHSC 103, 105, 199, or satisfactory score on the Clemson Mathematics Placement Test or consent of department.

**MTHSC 105 Precalculus 5(4,2)** Extensive treatment of topics chosen to prepare students for the study of calculus. Special emphasis is given to polynomial, rational, exponential, logarithmic, and trigonometric functions and their graphs, as well as basic and analytic trigonometry. Students who have received credit for any other mathematical sciences course will not be allowed to enroll in or receive credit for MTHSC 105. To be taken Pass/Fail only.

**MTHSC 106, H106 Calculus of One Variable I 4(4,0)** Topics include analytic geometry, introduction to derivatives, computation and application of derivatives, integrals, exponential and logarithm functions. *Preq:* MTHSC 103 or 105 or satisfactory score on the Clemson Mathematics Placement Test or consent of department.

**MTHSC 107 Differential and Integral Calculus 4(4,0)** Continuation of MTHSC 104. Successful completion of MTHSC 104 and MTHSC 107 is equivalent to the completion of MTHSC 106. Continuation of differential calculus and an introduction to integral calculus. Not open to students who have received credit for MTHSC 106. *Preq:* MTHSC 104.

**MTHSC 108, H108 Calculus of One Variable II 4(4,0)** Topics include transcendental functions, applications of integration, integration techniques, indeterminate forms, improper integrals, parametric equations, polar coordinates, and infinite series. *Preq:* MTHSC 106.

**MTHSC 109 Co-Calculus II 1(0,2)** Recitation style course to accompany MTHSC 108. Reinforces precalculus and calculus topics covered in MTHSC 108 and provides additional instruction and practice. Recommendations are made to students based on their scores on a Calculus Basic Skills Quiz, given at the beginning of each semester. *Preq:* Concurrent enrollment in MTHSC 108.

**MTHSC 111 Calculus II for Biologists 4(4,0)** Selected topics from integral calculus, eigenvalues and eigenvectors of matrices and differential equations are used to encourage the use of mathematics, computational tool and biological science in the study of relevant biological models. Credit toward a degree will be given for only one of MTHSC 108 and MTHSC 111. *Preq:* MTHSC 106.

**MTHSC 115 Contemporary Mathematics for Elementary School Teachers I 3(3,0)** Cooperative learning groups, manipulatives, and concrete models are used to demonstrate logical reasoning, problem-solving strategies, sets and their operations, numeration systems, properties and operations of whole numbers, number theory, prime and composite numbers, divisibility, common factors and multiples. Open to Elementary, Early Childhood, and Special Education majors only. *Preq:* MTHSC 104 or satisfactory score on the Clemson Mathematics Placement Test.

**MTHSC 116 Contemporary Mathematics for Elementary School Teachers II 3(3,0)** Continuation of MTHSC 115. Manipulatives and concrete models are used for properties, operations, and problem solving for integers, elementary fractions, rational numbers, and real numbers. Selected topics in statistics and probability are introduced with a hands-on approach to learning. Restricted to Elementary, Early Childhood, and Special Education majors. *Preq:* MTHSC 115 or consent of instructor.

**MTHSC 117 Mathematics for Elementary School Teachers I 3(2,2)** Problem-solving strategies, logic, algebraic thinking, sets, relations, functions, numeration systems, whole numbers, integers, number theory, fractions, decimals, applications of percent, real numbers with their computational algorithms and properties are explored. Content, according to state standards, is taught with appropriate methodology for teaching K–6. *Preq:* MTHSC 101.

**MTHSC 118 Mathematics for Elementary School Teachers II 3(2,2)** Simple probability and descriptive statistics are reviewed. Two- and three-dimensional geometry including polygons, polyhedra and their properties; congruence, similarity, and constructions; coordinate system; standard measurement, area, surface area, volume; and motion geometry are explored. Content, according to State standards, is taught with appropriate methodology for teaching K–6. *Preq:* MTHSC 117.

**MTHSC 119 Introduction to Discrete Methods 3(3,0)** Topics normally include elementary logic and methods of proof; sets, functions, and relations; graphs and trees; combinatorial circuits and Boolean algebra. *Preq:* Satisfactory score on the Clemson Mathematics Placement Test or consent of department.

**MTHSC 129 Problem Solving in Discrete Mathematics 3(2,2)** Problem-solving approach to learning mathematics is applied to topics in modern discrete mathematics. Typical selection of topics includes logic and proof, sets, relations, functions, mathematical induction, graphs and trees, counting techniques, recurrence equations. For Bachelor of Science and Bachelor of Arts majors in Mathematical Sciences only. Credit may not be received for both MTHSC 119 and 129. *Preq:* MTHSC 106.

**MTHSC 199 Problem Solving in Mathematics 3(2,2)** Functions and graphs, mathematical modeling, and applications. Applications from management and life and social sciences are presented. Specific topics include linear, quadratic, polynomial, exponential, and logarithmic functions with emphasis on problem solving. Students who have received credit for any other mathematical sciences course will not be allowed to enroll in or receive credit for MTHSC 199. To be taken Pass/Fail only.

**MTHSC 203 Elementary Statistical Inference 3(3,0)** Data-based course in statistical methodology: collecting and summarizing data, the normal distribution, one and two sample inference on means and proportions, simple linear regression, analysis of categorical data. May not be taken for credit by students who have passed MTHSC 301, 302, 309, or EX ST 301. *Preq:* Satisfactory score on the Clemson Mathematics Placement Test or MTHSC 101 or consent of department.

**MTHSC 206, H206 Calculus of Several Variables 4(4,0)** Topics include real valued functions of several variables, multiple integration, differential calculus of functions of several variables, vector field theory. *Preq:* MTHSC 108.

**MTHSC 207 Multivariable Calculus 3(3,0)** Introduction to the calculus of several variables, differential calculus and optimization of several variables, multiple integrals. Topics from the management sciences are used to illustrate the above concepts. May not be taken by students who have passed MTHSC 206. *Preq:* MTHSC 102, or 106 with consent of instructor.

**MTHSC 208, H208 Introduction to Ordinary Differential Equations 4(4,0)** Introduction to the study of differential equations and their application to physical problems. Topics include exact, series, and numerical solutions; solutions by means of Laplace transforms; and solutions of systems of differential equations. *Preq:* MTHSC 206.

**MTHSC 210 Applied Matrix Algebra 3(3,0)** Introduction to the basic principles of matrix algebra with applications to the behavioral and managerial sciences. Major areas of application include linear programming, directed graphs, and game theory. *Preq:* MTHSC 101 and 102 or 106.

**MTHSC 216 Geometry for Elementary School Teachers 3(3,0)** Informal treatment of the basic concepts of geometry. Open to Elementary, Early Childhood, and Special Education majors only. *Preq:* MTHSC 116 or consent of instructor.

**MTHSC 231 Mathematics of Life Insurance 3(3,0)** Introduction to basic mathematics of finance and life insurance. Topics include compound interest, annuities certain, mortality tables, life annuities, net premiums, net level reserves, modified reserves, nonforfeiture values, and dividends.

**MTHSC 250 Introduction to Mathematical Sciences 1(1,0)** Introduction to areas of study, degree options, career choices, and professional development in mathematical sciences. Includes guidelines and requirements for portfolio development and an introduction to ethical issues.

**MTHSC 299 Creative Inquiry—Mathematical Sciences 1-3(1-3,0)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of three credits.

**MTHSC 301, H301 Statistical Methods I 3(3,0)** Principal topics include collecting and summarizing data, probability distributions, inferences about central values and variation, analysis of categorical data, simple linear regression, basic experimental designs, and the analysis of variance. Credit toward a degree will be given for only one of MTHSC 301, 302, 309, EX ST 301. *Preq:* MTHSC 106 or 207 or 210.

**MTHSC 302 Statistics for Science and Engineering 3(3,0)** Methodology for collecting, organizing, and interpreting data. Topics include understanding variability, graphical and numerical summarization of data, introductory probability, normal and related distributions, statistical inference, experimental design, simple linear regression. Statistical microcomputer software is used. Credit toward a degree will be given for only one of EX ST 301, MTHSC 301, 302, 309. *Preq:* MTHSC 206.

**MTHSC 308 College Geometry 3(3,0)** Theorems and concepts more advanced than those of high school geometry. Treatment of the various properties of the triangle, including the notable points, lines, and circles associated with it. *Preq:* MTHSC 106.

**MTHSC 309 Introductory Business Statistics 3(3,0)** Introductory probability and statistics for business students, particularly those who will take MGT 310. Topics include descriptive statistics, probability, expectations, binomial, normal, sampling distributions, one and two sample estimation and testing. Credit toward a degree will be given for only one of EX ST 301, MTHSC 301, 302, 309. *Preq:* MTHSC 106 or 207 or 210.

**MTHSC 311, H311 Linear Algebra 3(3,0)** Introduction to the algebra of matrices, vector spaces, polynomials, and linear transformations. *Preq:* MTHSC 108 or consent of instructor.

**MTHSC 360 Intermediate Mathematical Computing 3(3,0)** Intermediate-level introduction in using computers to solve problems in the mathematical sciences. Fundamental concepts of procedural programming including flow control, modular construction, primitive data structures, recursion, and graphics are applied to problems in applied mathematics, probability, statistics, discrete mathematics, and operations research. *Preq:* MTHSC 108.

**MTHSC 365 Numerical Methods for Engineers 3(3,0)** Application of undergraduate mathematics and basic engineering principles with an emphasis on numerical methods, computer programming and the use of mathematical software packages in the solution of engineering problems. *Preq:* MTHSC 208 (or concurrent enrollment), ENGR 141.

**MTHSC H382 Honors Seminar 1(1,0)** Weekly seminar to prepare students in Departmental Honors Program for independent senior research. At the end of the second semester, each student must have identified a research topic and a faculty advisor. May be repeated for a maximum of two credits. *Preq:* Junior standing in departmental honors program.

**MTHSC 399 Creative Inquiry—Mathematical Sciences 1-3(1-3,0)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of three credits.

**MTHSC 400, H400, 600 Theory of Probability 3(3,0)** Principal topics include combinatorial theory, probability axioms, random variables, expected values; special discrete and continuous distributions, jointly distributed random variables, correlation, conditional expectation, law of large numbers, central limit theorem. *Preq:* MTHSC 206 or consent of instructor.

**MTHSC 403, H403, 603 Introduction to Statistical Theory 3(3,0)** Principal topics include sampling distributions, point and interval estimation, maximum likelihood estimators, method of moments, least squares estimators, tests of hypotheses, likelihood ratio methods, regression and correlation analysis, introduction to analysis of variance. *Preq:* MTHSC 400 or equivalent.

**MTHSC 405, 605 Statistical Theory and Methods II 3(3,0)** Principal topics include simple linear regression, multiple regression and correlation analysis, one-way analysis of variance, multiple comparison, multifactor analysis of variance, experimental design. Computation and interpretation of results are facilitated through use of statistical computer packages. *Preq:* MTHSC 301.

**MTHSC 406, 606 Sampling Theory and Methods 3(3,0)** Probability-based treatment of sampling methodology. Theory and application of estimation techniques are treated using simple and stratified random sampling, cluster sampling, and systematic sampling. *Preq:* MTHSC 302 and 400, or consent of instructor.

**MTHSC 407, 607 Regression and Time-Series Analysis 3(3,0)** Theory and application of the regression and time series. Approaches to empirical model building and data analysis are treated. Computation and interpretation of results are facilitated through the use of interactive statistical packages. *Preq:* MTHSC 302, 311, 400; or consent of instructor.

**MTHSC 408, 608 Topics in Geometry 3(3,0)** Introduction to topics in special geometries which include non-Euclidean space concepts such as projective geometry, finite geometries, and intuitive elementary topology. Brief introduction to vector geometry. *Preq:* MTHSC 206.

**MTHSC 410 Number Theory 3(3,0)** Introduction to theory of integers and related number systems. Topics include historical development, principle of mathematical induction, divisibility, primes, congruences, number-theoretic functions, primitive roots, quadratic residues, and diophantine equations. *Preq:* MTHSC 108 or consent of instructor.

**MTHSC 412, H412, 612 Introduction to Modern Algebra 3(3,0)** Introduction to the concepts of algebra. Topics include the number system and the elementary theory of groups, rings, and fields. *Preq:* MTHSC 311.

**MTHSC 419, H419, 619 Discrete Mathematical Structures I 3(3,0)** Applies theoretical concepts of sets, functions, binary relations, graphs, Boolean algebras, propositional logic, semigroups, groups, homomorphisms, and permutation groups to computer characteristics and design, words over a finite alphabet and concatenation, binary group codes, and other communication or computer problems. *Preq:* MTHSC 311.

**MTHSC 430 Actuarial Science Seminar I 1(1,0)** Problem-solving seminar to prepare students for the Society of Actuaries' Exam P or the Casualty Actuarial Society's Exam I (Probability). *Preq:* MTHSC 400 or consent of instructor.

**MTHSC 431 Theory of Interest 3(3,0)** Comprehensive treatment of the theory of interest including from a calculus-based continuous viewpoint. Topics include simple and compound interest and discount, nominal and effective rates, force of interest, basic and general annuities, yield rates, amortization and sinking funds, and applications to bonds, mortgages, and other securities. *Preq:* MTHSC 206.

**MTHSC 432 Actuarial Science Seminar II 1(1,0)** Problem-solving seminar to prepare students for the Society of Actuaries' Exam FM or the Casualty Actuarial Society's Exam 2 (Financial Mathematics). *Preq:* MTHSC 431.

**MTHSC 434, 634 Advanced Engineering Mathematics 3(3,0)** Fourier series, Laplace and Fourier transform, and numerical methods for solving initial value and boundary-value problems in partial differential equations are developed. Applications to diffusion wave and Dirichlet problems are given. Matrix methods and special functions are utilized. *Preq:* MTHSC 208.

**MTHSC 435, H435, 635 Complex Variables 3(3,0)** Elementary functions; differentiation and integration of analytic functions; Taylor and Laurent series; contour integration and residue theory; conformal mapping; Schwartz-Christoffel transformation. *Preq:* MTHSC 206.

**MTHSC 440, H440, 640 Linear Programming 3(3,0)** Introduction to linear programming covering the simplex algorithm, duality, sensitivity analysis, network models, formulation of models, and the use of simplex codes to solve, interpret, and analyze problems. *Preq:* MTHSC 206, 311, or consent of instructor.

**MTHSC 441, H441, 641 Introduction to Stochastic Models 3(3,0)** Introductory treatment of stochastic processes, finite-state Markov chains, queueing, dynamic programming, Markov decision processes, reliability, decision analysis, and simulation. Both theory and applications are stressed. *Preq:* MTHSC 400.

**MTHSC 450 Introduction to Mathematical Models 3(3,0)** Includes a study of the modeling process and examples of existing models chosen from physical, biological, social, and management sciences, depending on the instructor. Written and oral report is required for at least one of the models studied. May be repeated for a maximum of six credits. *Preq:* MTHSC 302, 360, 440, or consent of instructor.

**MTHSC 453, H453, 653 Advanced Calculus I 3(3,0)** Limits, continuity, and differentiation of functions of one and several variables, the Riemann integral, and vector analysis. *Preq:* MTHSC 206.

**MTHSC 454, H454, 654 Advanced Calculus II 3(3,0)** Continuation of MTHSC 453. Transformations, multiple integrals, line and surface integrals, infinite sequences and series, and improper integrals. *Preq:* MTHSC 453.

**MTHSC 460, 660 Introduction to Numerical Analysis I 3(3,0)** Introduction to the problems of numerical analysis emphasizing computational procedures and application. Topics include sources of error and conditioning, matrix methods, systems of linear equations, nonlinear equations, interpolation and approximation by splines, polynomials, and trigonometric functions. *Preq:* MTHSC 206 or 207 and 360 or equivalent.

**MTHSC 463, H463, 663 Mathematical Analysis I 3(3,0)** Basic properties of the real number system, sequences and limits; continuous functions, uniform continuity and convergence. Integration, differentiation, functions of several real variables, implicit function theory. *Preq:* MTHSC 206.

**MTHSC 481 Seminar in Mathematics 1-3(1-3,0)** Attention is focused on mathematical areas in which nonroutine problems can be posed with comparative ease. Emphasis is on independent study and student use of previously acquired mathematical skills. Open to students by invitation only for a maximum of three credits.

**MTHSC 482, H482 Undergraduate Research 3(3,0)** Independent research conducted under the supervision and guidance of a faculty member. May be repeated for a maximum of six credits.

**MTHSC 491 Independent Study 3(3,0)** Independent study or internship in mathematical sciences under faculty supervision. A written report and oral poster presentation of the results of the independent study or internship are required. May be repeated for a maximum of six credits.

*Preq:* Mathematical Sciences major.

**MTHSC 492 Professional Development 1(1,0)** Issues in professional development in the Mathematical Sciences. Individual portfolios are evaluated and critiqued for continued career use. To be taken Pass/Fail only.

**MTHSC 499 Creative Inquiry—Mathematical Sciences 1-3(1-3,0)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of three credits.