Mathematics (COSM)

MATH 0091
Algebra Lab: 1-0-1
Provides additional instruction on selected topics from MATH 1111 and is open to all students. MATH 0091 is a required course for any student who makes below a “C” in MATH 1111. Students required to take MATH 0091 must take it concurrently with MATH 1111 until they make at least a “C” in MATH 1111. Topics covered include a study of functions, equations, graphing, and operations with polynomial, rational and radical expressions. Also included are appropriate study skills and the use of technology. (Corequisite(s): MATH 1111) Audit or institutional credit only.

MATH 1101
Introduction to Mathematical Modeling: 3-0-3
Mathematical modeling using graphical, numerical, symbolic, and verbal techniques to describe and explore real-world data and phenomena. The investigation and analysis of applied problems and questions, and effective communication of quantitative concepts and results. Topics include linear, quadratic, polynomial, exponential and logarithmic models of real-world phenomena. Credit cannot be earned toward graduation for MATH 1111 if credit is earned for MATH 1101. Prerequisite(s): Two years of high school algebra or equivalent.

MATH 1111
College Algebra: 3-0-3
A functional approach to algebra that incorporates mathematical modeling of real data, business applications and use of appropriate technology. Emphasis will be placed on the study of linear, quadratic, piece-wise defined, rational, polynomial, exponential and logarithmic functions. Credit cannot be earned toward graduation for MATH 1111 if credit is earned for MATH 1101. Prerequisite(s): Two years of high school algebra or equivalent.

MATH 1112
Trigonometry: 3-0-3
Circular functions, solutions of triangles, trigonometric identities and equations, graphs of trigonometric functions, Law of Sines, Law of Cosines, applications, vectors, matrices, complex numbers, Euler's formula, DeMoivre's theorem. Appropriate technology will be used. Credit may not be received for both MATH 1112 and MATH 1113. Prerequisite(s): A minimum grade of “C” in MATH 1111 or equivalent.

MATH 1113
Pre-Calculus: 4-0-4
Emphasizes trigonometric functions and concepts and will include a review of selected topics from algebra including systems of equations and matrix algebra. The graphing calculator will be incorporated throughout the course. Prerequisite(s): A minimum grade of “C” in MATH 1111 or equivalent.
MATH 1232  
Survey of Calculus: 3-0-3  
Covers the fundamental elements of differential and integral calculus of algebraic, logarithmic and exponential functions. Topics include a brief review of algebraic principles, limits, derivatives and integrals. Appropriate technology will be incorporated throughout the course. Prerequisite(s): A minimum grade of “C” in MATH 1111 or MATH 1113 or equivalent.

MATH 1441/1441H  
Calculus I: 4-1-4  
This is the first of a sequence of courses which present a unified treatment of the differential and integral calculus. Topics include: limits, continuity, differentiation and integration, applications of the derivative and the integral. Prerequisite(s): A minimum grade of “C” in MATH 1112 or MATH 1113, or equivalent.

MATH 2008  
Foundations of Numbers and Operations: 3-0-3  
This course is an Area F introductory course for early childhood education majors. This course will emphasize the understanding and use of the major concepts of numbers and operations. As a general theme, strategies of problem solving will be used and discussed in the context of various topics. This course is also part of the program of study for middle grade majors. Prerequisite(s): A minimum grade of “C” in MATH 1111.

MATH 2010  
Problem Solving for K-8 Teachers: 3-0-3  
Students will learn, integrate and apply a variety of problem solving strategies to a range of mathematical problems from algebra, geometry and other areas of mathematics appropriate to the middle grades curriculum. Students will learn, integrate and apply appropriate technology as a tool in the problem solving process. For early childhood and middle grade majors only. Prerequisite(s): A minimum grade of "C" in MATH 3032.

MATH 2130  
Discrete Mathematics: 3-0-3  
Covers important discrete mathematical objects such as sets, relations and functions, graphs and trees. An introduction to mathematical logic and reasoning, and the concept of an algorithm and its complexity will be covered. Prerequisite(s): Prior or concurrent enrollment in MATH 1232, or a minimum grade of “C” in MATH 1111, MATH 1112, MATH 1113, MATH 1441, or MATH 2242.

MATH 2242/2242H  
Calculus II: 4-1-4  
Includes an introduction to transcendental functions, techniques of integration, improper integrals, infinite series and conics. Prerequisite(s): A minimum grade of “C” in MATH 1441 or equivalent.
MATH 2243/2243H  
Calculus III: 4-0-4  
Topics in real valued functions of several variables. Topics include polar coordinates, parametric equations, vectors in two and three dimensions, quadric surfaces, partial derivatives and applications, multiple integrals and applications, line integrals and Stoke's and Green's theorem. Prerequisite(s): A minimum grade of “C” in MATH 2242 or equivalent.

MATH 2331  
Elementary Linear Algebra: 3-0-3  
Matrices, solutions of linear systems, vector spaces and subspaces, orthogonality, determinants, eigenvalues and eigenvectors, linear transformation, diagonalization, and applications. Prerequisite(s): A minimum grade of “C” in MATH 1441.

MATH 2332  
Mathematical Structures: 3-0-3  
Topics include mathematical logic, methods of proofs, induction, set theory, relations, and functions. The course is primarily intended for mathematics and mathematics education majors as a first course in studying proof techniques and foundations of mathematics. Prerequisite(s): A minimum grade of “C” in MATH 1441.

MATH 2430  
Computing Techniques: 3-0-3  
Fundamentals of numerical methods and development of programming techniques with implementation in the computer solution of problems in engineering. Prerequisite(s): CSCI 1301 or ENGR 1731, MATH 2242, PHYS 2211. Corequisite(s): MATH 3230.

MATH 3032  
Foundations of Data Analysis and Geometry: 3-0-3  
A study of basic probability, statistics and geometry, including two and three dimensional shapes and triangle congruenced similarity. For Early Childhood and Middle Grade majors only. Prerequisite(s): A minimum grade of “C” in MATH 2008.

MATH 3130  
College Geometry: 3-0-3  
A study of absolute and Euclidean geometry. Prerequisite(s): A minimum grade of “C” in MATH 2332.

MATH 3230/3230H  
Ordinary Differential Equations: 3-0-3  
The study of differential equations involving functions of one variable. Topics include: linear and non-linear differential equations, initial value problems, existence and uniqueness theorems, systems of differential equations, stability, computational methods and Laplace transform methods.
Prerequisite(s): A minimum grade of “C” in MATH 2242.

MATH 3337
Probability: 3-0-3
An introduction to probability, random variables and discrete and continuous probability distributions for students in mathematics, engineering and the sciences including the social sciences and management science. Prerequisite(s): A minimum grade of “C” in MATH 2242 or equivalent.

MATH 4630
Game Theory: 3-0-3
This course is designed to introduce students to the foundations of game theory and its applications. Students will use reasoning skills to deal with concepts of games, networks, economic development, and warfare. Prerequisite(s): A minimum grade of "C" in MATH 2331 and MATH 2130 or MATH 2332.

MATH 4825H
Honors Research: 2-0-2
Independent research under the guidance of a faculty member in the Department of Mathematical Sciences for mathematics majors in the University Honors Program. Students must complete four credit hours over two semesters to complete the honors requirements. Prerequisite(s): Junior level or above; good standing in the University Honors Program.

MATH 4890
Directed Study in Mathematics: 0-(1-5)-(1-3)
Directed study under faculty supervision. Well prepared math majors may be permitted to enroll in an independent study upon the recommendation of a Mathematics faculty member. Prerequisite(s): Permission of instructor and department chair.

MATH 4920
Undergraduate Seminar: 2-0-2
A specialized study of various topics in mathematics with the intention to engage students in independent reading, writing and presentation of these topics under the supervision of mathematics faculty. Prerequisite(s): A minimum grade of “C” in MATH 2332 and MATH 2243.

MATH 4929H
Honors Thesis: 2-0-2
Written and oral presentation of results of research conducted in MATH 4825H (Honors Research). Honors thesis must follow the guidelines adopted by the University Honors Program. This course is required for mathematics majors in the University Honors Program. Prerequisite(s): A minimum grade of "C" in MATH 4825H, Junior level or above, and good standing in the University Honors Program.
MATH 4930  
**Senior Research Project: 3-0-3**
Main objective of this course is to engage senior undergraduate students in mathematical, statistical or computer science research and writing. Students will select advisors to work with on their projects. At least one oral presentation on the progress of their research during the semester is required. Also, a final written report on the project as well as a final oral presentation is required. Prerequisite(s): Students must have at least 15 credit hours of upper level mathematics, statistics and/or computer science.

MATH 5090  
**Selected Topics in Mathematics: (1-3)-(0-2)-(1-3)**
Specialized study in a selected area of Mathematics. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): Permission of instructor.

MATH 5130  
**Statistics and Probability for K-8 Teachers: 3-0-3**
An in-depth study of topics in statistics, such as sampling and data analysis, and probability, such as counting methods, odds, and expected value. For Early Childhood and Middle Grade majors only. Prerequisite(s): A minimum grade of “C” in MATH 3032.

MATH 5135  
**Algebraic Connections for K-8 Teachers: 3-0-3**
The evolution of algebraic concepts through the curriculum will be followed by how algebra is related to other areas of mathematics and real-world applications. For Early Childhood and Middle Grade majors only. Prerequisite(s): A minimum grade of “C” in MATH 3032.

MATH 5136  
**History of Mathematics: 3-0-3**
A survey of the historical development of mathematics. The emphasis will be on mathematical concepts, problem solving, and pedagogy from a historical perspective. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 2242 or permission of instructor.

MATH 5137  
**Geometry for K-8 Teachers: 3-0-3**
A continuation of the study of geometry from MATH 3032. Focus will be on two and three dimensional geometry. Motion geometry and tessellations will also be covered. For Early Childhood and Middle Grade majors only. Prerequisite(s): A minimum grade of “C” in MATH 3032.

MATH 5230  
**Advanced Geometry: 3-0-3**
Selected topics from Euclidean and Non-Euclidean Geometry. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 3130 or one year of teaching high school mathematics.

MATH 5232
Mathematical Applications Using Technology: 3-0-3
Selected mathematical topics used in research, problem solving, and demonstrations will be investigated with the use of current technologies. Intended for mathematics education majors. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 2243 and 3 hours of mathematics at the junior level or above.

MATH 5234
Number Theory: 3-0-3
Introduction to the principal ideas of elementary number theory: Divisibility, congruencies, linear Diophantine Equations, Fermat's Theorem, Euler's Theorem, Pythagorean triples and the distribution of primes. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 2332.

MATH 5236
Patterns of Problem Solving: 3-0-3
A study of patterns involved in solving problems. Particular attention is paid to Polya's heuristics and his characterization of the problem solving process. The student will also solve many problems. The application of these techniques by mathematics teachers will be stressed. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 1441 or permission of instructor.

MATH 5330
Operations Research: 3-0-3
Introduction to basic deterministic and probabilistic operations research models of decision problems. Mathematical methods of optimization for these models will be analyzed both analytically and numerically. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 2331 and MATH 3337 or permission of instructor.

MATH 5331
Analysis I: 3-0-3
Provides a transition from calculus to real analysis. Emphasis will be placed on understanding and constructing mathematical proofs. Rigorous development of fundamental concepts in analysis, including topics such as relations, functions, limits of functions, cardinality, topology of the reals, completeness axiom, compact sets, sequences, subsequence, continuity and
differentiability. Graduate students will be given an extra assignment
determined by the instructor that undergraduates will not be required to do.
Prerequisite(s): A minimum grade of “C” in MATH 2243 and MATH 2332.

MATH 5332
Analysis II: 3-0-3
A continuation of Analysis I, including topics such as Riemann integration,
infinite series, sequences and series of functions, metric spaces, and normed
spaces. Graduate students will be given an extra assignment determined by
the instructor that undergraduates will not be required to do. Prerequisite(s):
A minimum grade of “C” in MATH 5331/5331G.

MATH 5333
Modern Algebra I: 3-0-3
This course is an introduction to the fundamental algebraic structures:
groups, rings and fields. Topics covered include: binary operations, groups
(permutation groups, subgroups, cyclic groups, group homomorphisms,
factor groups), rings (integral domains, ring homomorphisms) and fields.
The historical and mathematical connections to the secondary mathematics
curriculum will be incorporated as appropriate. Graduate students will be
given an extra assignment not required of undergraduate students.
Prerequisite(s): A minimum grade of “C” in MATH 2332.

MATH 5334
Modern Algebra II: 3-0-3
A continuation of the study of the fundamental algebraic structures. Topics
to be covered include: isomorphism of groups, rings, fields, a deeper study
of quotient structures and the isomorphism theorems, field of quotients,
factorization of polynomials over a field, arithmetic properties of rings of
polynomials over fields, extension fields, algebraic extensions, geometric
constructions and the classic problems. Graduate students will be given an
extra assignment not required of undergraduate students. Prerequisite(s): A
minimum grade of “C” in MATH 5333/5333G.

MATH 5335
Intermediate Linear Algebra: 3-0-3
General vector spaces and bases, linear operators, least squares problems,
eigenvalue problems, and applications of these concepts. Graduate students
will be given an extra assignment determined by the instructor that
undergraduates will not be required to do. Prerequisite(s): A minimum grade
of “C” in MATH 2331 and MATH 2332.

MATH 5336
Applied Numerical Methods: 3-0-3
Introduction to scientific computation. Solutions of linear and nonlinear
equations, polynomial interpolation, numerical differentiation and
integration, data fitting, and other numerical methods. Graduate students
will be given an extra assignment determined by the instructor that
undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 2331 and knowledge of a programming language.

**MATH 5337**
**Difference Equations: 3-0-3**
This course is an introduction to the theory and applications of difference equations. Topics include the difference calculus, first order linear difference equations, results and solutions of linear equations, applications, equations with variable coefficients and nonlinear equations that can be linearized. Graduate students will be given an extra assignment not required of undergraduate students. Prerequisite(s): A minimum grade of "C" in MATH 2242 and MATH 2331.

**MATH 5338**
**Methods of Applied Mathematics: 3-0-3**
Methods of applied mathematics concentrating on techniques for the analysis of differential and integral equations. Topics include: Integral equations, differential operators, Fredholm alternative, distribution theory and Green's function methods. Graduate students will be given an extra assignment not required of undergraduate students. Prerequisite(s): A minimum grade of "C" in MATH 2331 and MATH 3230.

**MATH 5339**
**Partial Differential Equations: 3-0-3**
The study of differential equations involving functions of more than one variable. Topics include: Laplace, heat and wave equations, boundary value problems, methods of separation of variables and eigenfunction expansions, Fourier series, Green's functions, maximum principle and computational methods. Graduate students will be given an extra assignment not required of undergraduate students. Prerequisite(s): A minimum grade of "C" in MATH 2243 and MATH 3230.

**MATH 5430**
**Introduction to Mathematical Biology: 3-0-3**
An introduction to applications of mathematics to various biological, ecological, physiological, and medical problems, which will be analyzed both analytically and numerically. Graduate students will be given additional assignments that will not be completed by undergraduate students. Prerequisite(s): A minimum grade of “C” in MATH 3230 or permission of instructor.

**MATH 5431**
**Combinatorics and Graph Theory: 3-0-3**
The course covers basic theory and applications of combinatorics and graph theory. Combinatorics is a study of different enumeration techniques of finite but large sets. Topics that will be studied include principle of inclusion and exclusion, generating functions and methods to solve difference equations. Graph theory is a study of graphs, trees and networks. Topics that will be discussed include Euler formula, Hamilton paths, planar
graphs and coloring problem; the use of trees in sorting and prefix codes; and useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm. Graduate students will be given extra assignments determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of "C" in MATH 2332 and MATH 3337.

MATH 5433
Differential Geometry of Curves and Surfaces: 3-0-3
Differential geometry uses tools from calculus and linear algebra to study the geometric properties of smooth curves and surfaces in Euclidean spaces. Topics include: arc length surface area, geodesics, curvature, first and second fundamental forms, Gauss-Bonnet formula. Graduate students will be assigned additional assignments and/or project. Prerequisite(s): A minimum grade of “C” in MATH 2243 and MATH 2331.

MATH 5434
Functions of a Complex Variable: 3-0-3
Topics in complex variables including functions, limits, derivatives, integrals, the Cauchy-Riemann conditions, series representation of functions, Cauchy Integral formula, and elementary conformal mappings. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 2332.

MATH 5435
Introduction to Topology: 3-0-3
An introduction to metric spaces, topological spaces, connectedness and compactness of topological spaces, and continuous functions on topological spaces. Graduate students enrolled in this course will complete one or more assignments that the undergraduate students will not be required to complete. A minimum grade of “C” in MATH 2332.

MATH 5436
Introduction to Fractals: 3-0-3
Fractals as nonlinear systems involving feedback and iteration. Classical fractals, limits and self-similarity. Fractal dimensions. Encoding of fractals. Decoding of fractals. Iterated function systems. Graduate students will be given an extra assignment determined by the instructor that undergraduates will not be required to do. Prerequisite(s): A minimum grade of “C” in MATH 5331 or MATH 5331G.

MATH 5437
Mathematics and Computation of Curves and Surfaces: 3-0-3
This course is a study of the mathematical and computational techniques used for the computer generation of curves and surfaces. The primary representations for the curves and surfaces are univariate and multivariate polynomials and splines in the Bernstein/Bezier and B-spline bases. These curves and surfaces are used for data fitting (interpolation and smoothing)
and approximation. Topics include: recursion, smoothness, surfaces over grids, surfaces over triangulations, simplex and box splines, variational curves and surfaces, transformations and projections. Graduate students will be given an extra assignment not required of undergraduate students. Prerequisite(s): A minimum grade of "C" in MATH 2243 and MATH 2331.

**MATH 5530**  
**Mathematics for Scientists and Engineers: 3-0-3**  
A survey of mathematical topics useful in the study of areas of applied sciences such as physics, engineering and computer science. Topics include: linear algebra and matrices, ordinary differential equations, partial differential equations, Fourier series, vector calculus, complex variables, numerical methods, probability and graph theory. For non-math majors only. Graduate students will be given an extra assignment not required of undergraduate students. Prerequisite(s): A minimum grade of "C" in MATH 2242.

**MATH 5539**  
**Mathematical Models: 3-0-3**  
This course introduces students to a variety of mathematical tools used for solving real world problems, with the focus on identifying the problem, constructing an appropriate model, and finding the best available method to solve it. Graduate students will be given an extra assignment not required of undergraduate students. Prerequisite(s): A minimum grade of "C" in MATH 2331 and MATH 3230.