DEPARTMENT OF MATHEMATICAL SCIENCES

College of Arts and Sciences
Department of Mathematical Sciences
233 Mathematics and Computer Science Building
Kent Campus
330-672-2430
math@math.kent.edu
www.kent.edu/math

Undergraduate Programs

- Actuarial Mathematics - B.S.
- Applied Mathematics - B.S.
- Mathematics - B.A.
- Mathematics - B.S.

Minors

- Applied Mathematics
- Applied Statistics
- Mathematics

Graduate Programs

- Applied Mathematics - M.A.
- Applied Mathematics - M.S.
- Applied Mathematics - Ph.D.
- Data Science - M.S.
- Mathematics for Secondary School Teachers - M.A.
- Pure Mathematics - M.A.
- Pure Mathematics - M.S.
- Pure Mathematics - Ph.D.

Department of Mathematical Sciences Faculty

- Adams, Lynn (2007), Senior Lecturer, M.S., University of Akron, 2007
- Al-Niemi, Fearase (2024), Lecturer, University of Akron, 2011
- Alexopoulos, John K. (1994), Associate Professor, Ph.D., Kent State University, 1992
- Allen, Aaron C. (2014), Lecturer, B.S., Rensselaer Polytechnic Institute , 2011
- Allouba, Hassan A. (2002), Associate Professor, Ph.D., Cornell University, 1996
- Altobelli, Joseph A. (1997), Associate Professor, Ph.D., The Ohio State University, 1996
- Andaloro, Paul J. (1994), Assistant Professor, Ph.D., The Ohio State University, 1989
- Andriyevskyy, Volodymyr (2000), Professor, Ph.D., Institute of Mathematics of Ukrainian Academy of Sciences, 1986
- Arokiasamy, Daisy Malini (2015), Lecturer, M.S., Kent State University, 2016
- Barb, Cynthia M. (1990), Associate Professor, Ph.D., Kent State University, 1997
- Benjamin, Judy I. (2002), Assistant Professor, Ph.D., Kent State University, 2022
- Chebotar, Mikhail (2006), Professor, Ph.D., Moscow State University, 1999
- Clos, Timothy G. (2020), Assistant Professor, Ph.D., University of Toledo, 2017
- Das, Lovejoy S. (1989), Professor, Ph.D., University of Lucknow, 1979
- Davidson, Morley A. (1996), Associate Professor, Ph.D., University of Michigan, 1995
- de la Cruz Cabrera, Omar (2016), Associate Professor
- Dhaher, Yaser Y. (1989), Professor, Ph.D., Kent State University, 2007
- Dinh, Hai Q. (2004), Professor, Ph.D., Ohio University, 2003
- Dunlap, Laurie A. (2021), Associate Professor, Ph.D., University of Cincinnati, 2005
- Fesli, Emily E. (2021), Lecturer, M.S., Cleveland State University, 2021
- Gordon, Peter (2017), Professor, Ph.D., Moscow University, 1999
- He, Min (1995), Professor, Ph.D., Southern Illinois University-Carbondale, 1994
- Hovhannisyan, Gro (2003), Professor, Ph.D., Yerevan State University, 1990
- Jahangiri, Jay M. (1994), Professor, Ph.D., University of York, 1986
- Jiafeng, Jin (2014), Assistant Professor, Ph.D., Kent State University, 2024
- Kasturiarachi, Aloysius B. (1995), Associate Professor, Ph.D., University of North Carolina-Charlotte, 1993
- Khan, Mohammad K. (1981), Professor, Ph.D., Case Western Reserve University, 1980
- Kover, Janice S. (1996), Associate Professor, Ph.D., Kent State University, 2001
- Kracht, Darci L. (1984), Professor, Ph.D., Kent State University, 2011
- Kratky, Joseph J. (2005), Associate Lecturer, M.S., Kent State University, 2011
- Laux, Tracy A. (1990), Senior Lecturer, B.S., Kent State University, 1990
- Law, Chelsea C. (2021), Associate Lecturer, M.S., Clemson University, 2012
- Lewis, Mark L. (1996), Professor, Ph.D., University of Wisconsin-Madison, 1995
- Li, Jing (2003), Associate Professor, Ph.D., New York University, 2002
- Li, Jun (2013), Associate Professor, Ph.D., Iowa State University, 2013
- Lochmueller, Kerri K. (2005), Associate Lecturer, M.S., Youngstown State University, 2008
- Meinke, Ashley M. (2009), Lecturer, M.S., Kent State University, 2011
- Miller, Robert L. (2021), Lecturer, M.S., Miami University, 2006
- Mocioalca, Oana (2004), Associate Professor, Ph.D., University of Florida, 2002
- Mulqueeny, Ellen S. (2005), Professor, M.S., Cleveland State University, 1993
- Najafi, Mahmoud (1995), Professor, Ph.D., Wichita State University, 1994
- Nazarov, Fedor L. (2011), Professor, M.S., Youngstown State University, 1990
- Neal, Todd A. (2010), Assistant Professor, Ph.D., University of Alabama, 2016
- Ngunkeng, Grace (2021), Associate Professor, Ph.D., Bowling Green State University, 2013

- Osikiewicz, Beth-Allyn (1994), Associate Professor, Ph.D., Kent State University, 2000
- Osikiewicz, Jeffrey A. (1990), Associate Professor, Ph.D., Kent State University, 1997
- Palffy-Muhoray, Peter (1987), Professor
- Palocyi, Frank J. (1991), Associate Lecturer, M.S., Youngstown State University, 1990
- Perera, Vicumpriya S. (1998), Associate Professor, Ph.D., Purdue University, 1993
- Pham, Tuyet D. (1988), Senior Lecturer, M.S., University of Akron, 1988
- Rajaram, Rajeev (2008), Professor, Ph.D., Iowa State University, 2005
- Reed, Beverly M. (1986), Professor, Ph.D., Kent State University, 2007
- Reichel, Lothar (1991), Professor, Ph.D., University of Stockholm, 1982
- Ritchey, Nathan P. (2016), Professor
- Ruff, Oliver (2009), Associate Professor, Ph.D., University of Oregon, 2002
- Ryabogin, Dmitry (2007), Professor, Ph.D., University of Jerusalem, 2001
- Sarver, Michael W. (2021), Associate Professor, Ph.D., Bowling Green State University, 2006
- Schmalzried, Robert J. (2017), Associate Lecturer, M.S.Ed., Youngstown State University, 2004
- Smithies, Laura A. (1997), Associate Professor, Ph.D., University of Utah, 1997
- Soprunova, Evgenia (2007), Professor, Ph.D., University of Toronto, 2002
- Spalsbury, Angela S. (2018), Associate Professor, Ph.D., Kent State University, 1996
- Stadden, Jared M. (2013), Associate Lecturer, M.B.A., Kent State University, 2012
- Taha, Nader F. (1990), Senior Lecturer, M.S., Tennessee State University, 1989
- Trehan, Dawn M. (2019), Assistant Professor, M.S., Case Western Reserve, 1996
- Tsai, Tsung-Heng (2019), Associate Professor, Ph.D., Virginia Tech, 2014
- Vezvaei, Mahbobeh (1983), Professor, Ph.D., Case Western Reserve University, 1987
- Vorhauer, Ulrike M. (2001), Associate Professor, Ph.D., University of Ulm, 1996
- Wakita, Hideki (1998), Senior Lecturer, M.A., Kent State University, 2002
- White, Donald L. (1989), Professor, Ph.D., Yale University, 1987
- Wright, Brian M. (1998), Associate Professor, Ph.D., Kent State University, 2007
- Yeon, Hyemin (2024), Assistant Professor, Ph.D., Iowa State University, 2023
- Yu, Gang (2006), Associate Professor, Ed.D., University of Georgia, 2000
- Zheng, Xiaoyu (2006), Professor, Ph.D., University of North Carolina-Chapel Hill, 2006
- Zvavitch, Artem (2004), Professor, Ph.D., Weizmann Institute of Science, 2002

Mathematics (MATH)

MATH 00020   PRE-ALGEBRA   2 Credit Hours
Course covers properties of whole numbers, fractions, decimals, percents, signed numbers and order of operations. Mental math and elementary algebraic thinking skills are emphasized. Use of calculators is not allowed. Course does not count toward graduation.
Prerequisite: 0-9 ALEKS math score.
Schedule Type: Emporium
Contact Hours: 2 other
Grade Mode: Standard Letter

MATH 00021   BASIC ALGEBRA I   2 Credit Hours
Course includes operations on integers, fractions, decimals and percents, and properties of real numbers. Introduction to variables, first degree equations and problem-solving with formulas. Equations and inequalities in one variable, linear equations, rate of change and slope, graphing in the cartesian plane. Course does not count toward graduation.
Prerequisite: Minimum 10 ALEKS math score.
Pre/corequisite: MATH 00020 with a minimum C grade.
Schedule Type: Emporium
Contact Hours: 2 other
Grade Mode: Standard Letter

MATH 00022   BASIC ALGEBRA II   2 Credit Hours
Introduction to functions, systems of linear equations, exponents, polynomial operations, scientific notation. Factoring polynomials, solving quadratics by factoring, radicals and rational exponents. Course does not count toward graduation.
Prerequisite: Minimum 25 ALEKS math score; or MATH 00021 with a minimum C grade.
Schedule Type: Emporium
Contact Hours: 2 other
Grade Mode: Standard Letter

MATH 00095   SPECIAL TOPICS IN MATHEMATICS   1-4 Credit Hours
(Repeatable for credit) Topics in mathematics not covered in regular courses. Offered when opportunities and resources permit; the topic is announced when the course is scheduled. Course does not count toward graduation.
Prerequisite: None.
Schedule Type: Emporium
Contact Hours: 1-4 other
Grade Mode: Standard Letter

MATH 10040   INTRODUCTORY STATISTICS PLUS (KMCR)   5 Credit Hours
(Equivalent to MATH 10041) An introduction to statistical thinking and statistical methods with a review of basic algebra. Emphasis is on statistical literacy, conceptual understanding and active learning in the classroom. This course also provides just-in-time remediation to help students achieve the same learning outcomes as MATH 10041. No credit earned for this course if a student already earned credit for MATH 10041. Students who do not meet the prerequisites but do have a minimum of 3.0 high school GPA should contact the department for approval to register.
Prerequisite: ALEKS Math score between 25 and 34; or MATH 00021 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 5 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, TAG Mathematics, Transfer Module Mathematics

MATH 10041   INTRODUCTORY STATISTICS (KMCR)   4 Credit Hours
(Equivalent to MATH 10040) An introduction to statistical thinking and statistical methods. Emphasis is on statistical literacy, conceptual understanding and active learning in the classroom. No credit earned for this course if a student already earned credit for MATH 10040. Students who do not meet the prerequisites but do have a minimum of 3.5 high school GPA should contact the department for approval to register.
Prerequisite: Minimum 22 ACT math score; or minimum 530 SAT math score; or minimum 35 ALEKS Math score; or MATH 00022 with a minimum C grade; or any higher level MATH course.
Schedule Type: Emporium
Contact Hours: 4 other
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 10050   QUANTITATIVE REASONING PLUS (KMCR)   5 Credit Hours
(Equivalent to MATH 10051) In the broadest sense mathematics should provide students the needed quantitative tools, logical reasoning and problem-solving skills, and a sense that quantitative modeling can be used to describe and understand developments in many areas of daily living. Since critical thinking is the primary objective and outcome for our course, in each area of concentration (numeracy, mathematical modeling, and probability and statistics) students will need to read and glean information from the problem situation, convert the information into a usable form, perform any needed routine calculations, make or draw a conclusion, and then communicate the result via explanation using quantitative reasoning by writing coherent statements and paragraphs. This course also provides just-in-time remediation to help students achieve the same learning outcomes as MATH 10051. Students who do not meet the prerequisites but do have a minimum of 3.0 high school GPA should contact the department for approval to register.
Prerequisite: ALEKS Math score between 25 and 34; or MATH 00021 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 5 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, TAG Mathematics, Transfer Module Mathematics

MATH 10051   QUANTITATIVE REASONING (KMCR)   4 Credit Hours
(Equivalent to MATH 10050) In the broadest sense, mathematics should provide students the needed quantitative tools, logical reasoning and problem solving skills, and a sense that quantitative modeling can be used to describe and understand developments in many areas of daily living. Since critical thinking is the primary objective and outcome for this course, in each area of concentration (numeracy, mathematical modeling and probability and statistics), students will read and glean information from the problem situation, convert the information into a usable form, perform any needed routine calculations, make or draw a conclusion, and then communicate the result via explanation using quantitative reasoning by writing coherent statements and paragraphs. Students who do not meet the prerequisites but do have a minimum of 3.5 high school GPA should contact the department for approval to register.
Prerequisite: Minimum 22 ACT math score; or minimum 530 SAT math score; or minimum 35 ALEKS Math score; or MATH 00022 with a minimum C grade; or any higher level MATH course.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning

MATH 10675   ALGEBRA FOR CALCULUS BOOST (KMCR)   5 Credit Hours
(Equivalent to MATH 10775 or MATH 11010) Course includes an extensive and rich immersion into the structure of functions. Routine analysis includes discussion of domain, range, zeros, general function behavior (increasing, decreasing, extrema, etc.). Operations with functions, including addition, subtraction, multiplication, division, composition and inversion. Functions are studied as a tool to analyze rates of change in real-world scenarios. The emphasis is on linear, polynomial, exponential and rational functions, with an extensive problem-solving component. A two-week review of intermediate algebra skills is included in the course, as is extra time studying quadratic functions, absolute value functions, systems of equations and extended time on logarithms. Students who do not meet the prerequisites but do have a minimum of 3.5 high school GPA should contact the department for approval to register.
Prerequisite: Minimum 22 ACT math score; or minimum 530 SAT math score; or ALEKS math score between 35-44; or MATH 00022 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 5 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning

MATH 10771   BASIC MATHEMATICAL CONCEPTS I PLUS (KMCR)   5 Credit Hours
(Equivalent to MATH 14001) Course covers the development of the real-number system and its sub-systems, open sentences, numeration systems, modular arithmetic and some number theory concepts. Additional concepts covered include place value, logic, equality, properties of the real numbers, multiple representations of operations with numbers, and problem solving. Students who do not meet the prerequisites but do have a minimum of 3.5 high school GPA should contact the department for approval to register.
Prerequisite: Minimum 35 ALEKS math score; or minimum 22 ACT math score; or minimum 530 SAT math score; or MATH 00022 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 5 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning

MATH 10772   MODELING ALGEBRA PLUS (KMCR)   5 Credit Hours
(Equivalent to MATH 11009) Study of algebra arising in the context of real-world applications, including linear, polynomial, exponential and logarithmic models. Includes a review of factoring and functions. Course is intended for students not planning to take calculus. No credit earned toward a degree for this course if student already earned credit for MATH 11010. Students who do not meet the prerequisites but do have a minimum of 3.5 high school GPA should contact the department for approval to register.
Prerequisite: Minimum 35 ALEKS math score; or minimum 22 ACT math score; or minimum 530 SAT math score; or MATH 00022 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 5 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning

MATH 10775   ALGEBRA FOR CALCULUS PLUS (KMCR)   4 Credit Hours
(Equivalent to MATH 10675 or MATH 11010) Course includes an extensive and rich immersion into the structure of functions. Routine analysis includes discussion of domain, range, zeros, general function behavior (increasing, decreasing, extrema, etc.). Operations with functions, including addition, subtraction, multiplication, division, composition and inversion. Functions are studied as a tool to analyze rates of change in real-world scenarios. The emphasis is on linear, polynomial, exponential and rational functions, with an extensive problem-solving component. Skill review is included in the course, as is time studying quadratic functions, absolute value functions, systems of equations and extended time on logarithms.
Prerequisite: ALEKS math score between 45 and 54; or MATH 10772 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning

MATH 11008   EXPLORATIONS IN MODERN MATHEMATICS (KMCR)   3 Credit Hours
Topics from various branches of mathematics will be chosen to introduce the student to the wide varieties of ways in which mathematics affects everyday life. Students who do not meet the prerequisites but do have a minimum of 3.5 high school GPA should contact the department for approval to register.
Prerequisite: Minimum 35 ALEKS math score; or minimum 22 ACT math score; or MATH 00022 or any higher MATH course with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning

MATH 11009   MODELING ALGEBRA (KMCR)   4 Credit Hours
(Equivalent to MATH 10772) Study of algebra arising in the context of real-world applications, including linear, polynomial, exponential and logarithmic models. Intended for students not planning to take calculus. No credit earned toward a degree for this course if the student already earned credit for MATH 11010.
Prerequisite: Minimum 45 ALEKS math score.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning

MATH 11010   ALGEBRA FOR CALCULUS (KMCR)   3 Credit Hours
(Equivalent to MATH 10675 or MATH 10775) Course includes an extensive and rich immersion into the structure of functions. Routine analysis includes discussion of domain, range, zeros, general function behavior (increasing, decreasing, extrema, etc.). Operations with functions, including addition, subtraction, multiplication, division, composition and inversion. Functions are studied as a tool to analyze rates of change in real-world scenarios. Emphasis is on linear, polynomial, exponential and rational functions, with an extensive problem-solving component.
Prerequisite: Minimum 55 ALEKS math score; or MATH 10772 or MATH 11009 with a minimum B grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 11012   INTUITIVE CALCULUS (KMCR)   3 Credit Hours
Course is designed to give an overview of differential and integral calculus to business and life-science majors. Course does not include trigonometric functions. No credit earned toward a degree for this course if the student already earned credit for MATH 12002.
Prerequisite: Minimum 67 ALEKS math score; or minimum C grade in MATH 10675 or MATH 10775 or MATH 11010.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 11022   TRIGONOMETRY (KMCR)   3 Credit Hours
Solution of triangles, trigonometric equations and identities.
Prerequisite: Minimum 67 ALEKS math score; or minimum C grade in MATH 10675 or MATH 10775 or MATH 11010.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 12002   ANALYTIC GEOMETRY AND CALCULUS I (KMCR)   5 Credit Hours
Concepts of limit, continuity and derivative, and the indefinite and definite integral for functions of one real variable. Maximization, related rates, fundamental theorem of calculus. No credit earned toward a degree for this course if the student already earned credit for MATH 12011 and MATH 12012.
Prerequisite: Minimum 78 ALEKS math score; or MATH 11022 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 5 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 12003   ANALYTIC GEOMETRY AND CALCULUS II   5 Credit Hours
Continued study of techniques and applications of integration; trigonometric, logarithmic and exponential functions; polar coordinates; vectors; parametric equations; sequences and series.
Prerequisite: MATH 12002 or MATH 12012 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 5 lecture
Grade Mode: Standard Letter
Attributes: Transfer Module Mathematics

MATH 12011   CALCULUS WITH PRECALCULUS I (KMCR)   3 Credit Hours
Introduction to differential calculus with a review of algebra and trigonometry. Includes exponents, factoring, functions, graphs, tangent lines, limits, continuity, derivatives and related rates. No credit earned toward a degree for this course if the student already earned credit for MATH 12002.
Prerequisite: Minimum 67 ALEKS math score.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 12012   CALCULUS WITH PRECALCULUS II (KMCR)   3 Credit Hours
Development of integral calculus and continued study of differential calculus. Includes curve sketching optimization fundamental theorem of calculus areas between curves, exponential and logarithmic functions. No credit earned toward a degree for this course if student already earned credit for MATH 12002.
Prerequisite: MATH 12011 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 12013   BRIEF CALCULUS II   3 Credit Hours
This is a condensed version of MATH 12003 to meet the needs of majors that do not require the full force of MATH 12003. The course starts with integration by parts, approximating integrals, and applications of integrals. It follows with a brief introduction to series, parametric equations and polar coordinates, and finishes with vectors and geometry of space. No credit earned toward a degree for this course if student already earned credit for MATH 12003.
Prerequisite: Minimum C grade in MATH 12002 or MATH 12012 or MATH 12021.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 12021   CALCULUS FOR LIFE SCIENCES   4 Credit Hours
Differential and integral calculus using examples and problems in life sciences.
Prerequisite: Minimum 78 ALEKS math score; or MATH 11022 or MATH 12011 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 12022   PROBABILITY AND STATISTICS FOR LIFE SCIENCES   3 Credit Hours
Probability and statistics with applications in medical and biological sciences.
Prerequisite: Minimum C grade in MATH 12002 or MATH 12012 or MATH 12021.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 14001   BASIC MATHEMATICAL CONCEPTS I (KMCR)   4 Credit Hours
(Equivalent to MATH 10771) Development of the real number system and its sub-systems, open sentences, numeration systems, modular arithmetic and some number theory concepts.
Prerequisite: MATH 10675 or any higher level MATH course (except MATH 11008) with a minimum C grade; or minimum 45 ALEKS math score.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 14002   BASIC MATHEMATICAL CONCEPTS II (KMCR)   4 Credit Hours
Basic concepts of probability, statistics and geometry.
Prerequisite: MATH 10771 or MATH 14001 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter
Attributes: Kent Core Mathematics and Critical Reasoning, Transfer Module Mathematics

MATH 19002   TECHNICAL MATHEMATICS II   4 Credit Hours
Emphasizes advanced topics in algebra and trigonometry, analytic geometry, derivatives and integrals.
Prerequisite: None.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 19099   FIELD EXPERIENCE IN MATHEMATICS INSTRUCTION (ELR)   1 Credit Hour
(Repeatable for credit) Learning through tutoring. A supervised lab experience in providing explanations of mathematical concepts.
Prerequisite: Special approval.
Schedule Type: Lecture
Contact Hours: 1 lecture
Grade Mode: Standard Letter
Attributes: Experiential Learning Requirement

MATH 20011   DECISION-MAKING UNDER UNCERTAINTY   3 Credit Hours
An introductory course on applied statistics. The course provides a hands-on approach to understanding, quantification and decision-making under various forms of uncertainty. The main topics include visualization of uncertainty, probabilistic quantification of uncertainty, Bayesian and non-Bayesian ways of decision-making under uncertainty. Class activities incorporate active learning elements, including in-classroom computation with professional-grade software for statistical analysis and simulation.
Prerequisite: MATH 12002 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 20095   SPECIAL TOPICS IN MATHEMATICS   1-5 Credit Hours
(Repeatable for credit) Various special courses will be announced in the schedule of classes under this course number with different section numbers.
Prerequisite: Special approval.
Schedule Type: Lecture
Contact Hours: 1-5 lecture
Grade Mode: Standard Letter

MATH 21001   LINEAR ALGEBRA   3 Credit Hours
Systems of linear equations and the associated matrix operations, linear transformations, vector spaces, bases, eigenvectors.
Prerequisite: Minimum C grade in MATH 11012 or MATH 12002 or MATH 12012 or MATH 12021.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: TAG Mathematics

MATH 21002   APPLIED LINEAR ALGEBRA   3 Credit Hours
This is an introductory course in linear algebra. The goal of the course is to teach the math fundamentals of linear algebra in a way that focuses more on applications. The topics include systems of linear equations, matrix operations, vector spaces, eigenvalues and eigenvectors, singular value decompositions, and their applications.
Prerequisite: Minimum C grades in MATH 12002 or MATH 11012 or MATH 12012 or MATH 12021.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 21092   COMPUTER PRACTICUM (ELR)   2 Credit Hours
(Repeatable for credit) Supervised work experience in a computer installation.
Prerequisite: None.
Schedule Type: Practical Experience
Contact Hours: 2 other
Grade Mode: Standard Letter
Attributes: Experiential Learning Requirement

MATH 22005   ANALYTIC GEOMETRY AND CALCULUS III   4 Credit Hours
Study of functions of several variables, including partial derivatives and multiple integrals.
Prerequisite: MATH 12003 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter
Attributes: TAG Mathematics

MATH 23022   DISCRETE STRUCTURES FOR COMPUTER SCIENCE   3 Credit Hours
(Cross-listed with CS 23022) Discrete structures for computer scientists with a focus on: mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking, applications and modeling. Specific topics include propositional and predicate logic and logical modeling using Boolean algebra and logical gates, information representation using binary system, sets, functions, relations, logical argumentation, proof techniques, recursion and recursive modeling, sequences and summation, arithmetic and geometric progressions, algorithms, iterative vs recursive algorithms, mathematical and structural induction, recursive structures, counting, permutation and combination, binomial expansion, matrices and matrix-operations, graphs and trees and their traversal, probability and Bayes' theorem, finite state machines, their modeling and applications, Regular grammar, basics of number theory, modeling computation and Turing machines, decidability and halting problem.
Prerequisite: Minimum C grade in MATH 11009 or MATH 11010 or MATH 11022, or ALEKS score of 78.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 30011   BASIC PROBABILITY AND STATISTICS   3 Credit Hours
Analysis and representation of data. Controlled experiments and observations. Measurement errors. Correlation and regression. Sampling. Probability models and tests of models. Inference. This course cannot be used to meet the mathematics requirements for a BA in Mathematics or a BS in Applied Mathematics or Mathematics.
Prerequisite: Minimum 67 ALEKS math score; or minimum C grade in MATH 10675 or MATH 10775 or MATH 11010; or any course MATH 11012 to MATH 12022; or any course MATH 20000 to MATH 49999.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 30055   MATHEMATICAL THEORY OF INTEREST   3 Credit Hours
A calculus-based introduction to the mathematics of finance. Limited to deterministic analysis of interest rates annuities bonds and immunization. Emphasizes the mathematical theory of the subject matter.
Prerequisite: MATH 12003 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 31011   PROOFS IN DISCRETE MATHEMATICS   3 Credit Hours
The study of discrete mathematical structures including sets, functions and relations. The course includes an introduction to logical thinking with an emphasis on proof techniques. The course may include topics in number theory, graph theory and combinatoric.
Prerequisite: MATH 12002 with a minimum C grade.
Pre/corequisite: Minimum C grade in the following courses: MATH 21001 or MATH 21002 or MATH 32051.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 32044   ORDINARY DIFFERENTIAL EQUATIONS   3 Credit Hours
An introduction to ordinary differential equations and applications. Topics include solution methods, series solutions and singular points. Laplace transforms and linear systems. Applications include population dynamics, forced oscillations and resonance.
Prerequisite: Minimum C grade in the following courses: MATH 21001 or MATH 21002; and MATH 22005.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: TAG Mathematics

MATH 32051   MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I   4 Credit Hours
Mathematics background beyond calculus I and II for upper-division courses in the physical sciences. Topics include complex numbers and arithmetic, linear algebra, partial differentiation and multiple integrals.
Prerequisite: MATH 12003 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 32052   MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II   4 Credit Hours
Additional mathematics background for upper-division courses in the physical sciences. Topics include vector analysis, Fourier series and transforms ordinary differential equations and partial differential equations.
Prerequisite: MATH 32051 with a minimum C grade; or MATH 21001 and MATH 22005 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 34001   FUNDAMENTAL CONCEPTS OF ALGEBRA   3 Credit Hours
Professionalized course in algebra for prospective secondary teachers. Postulational development of number system of algebra; other systems, related topics, applications. This course cannot be used to meet the mathematical requirements for a BA in Mathematics or a BS in either Applied Mathematics or Mathematics. No credit earned toward a degree for this course if a student already earned credit for MATH 41001.
Prerequisite: MATH 12002 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 34002   FUNDAMENTAL CONCEPTS OF GEOMETRY   3 Credit Hours
Professionalized course in geometry for secondary school teachers. Origin and development of the geometry of Euclid with modern refinements, topics, approaches. Other geometries, applications. This cannot be used to meet the mathematics requirement for a BA in Mathematics or a BS in either Applied Mathematics or Mathematics.
Prerequisite: MATH 12002 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 38001   HANDS-ON MATHEMATICS   3 Credit Hours
Students take turns learning a topic and then teach that topic to the class. No text is required; the students use web resources and materials supplied by the instructor. Many of the topics have a hands-on component. Some examples are two- and three-dimensional tiling problems, the Towers of Hanoi and other problems with an inductive solution, and 'magic tricks' with a basis in algebra, parity or modular arithmetic.
Prerequisite: MATH 12003 with a minimum C grade.
Schedule Type: Seminar
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 40011   PROBABILITY THEORY AND APPLICATIONS   3 Credit Hours
(Slashed with MATH 50011) Permutations and combinations, discrete and continuous distributions, random variables, conditional probabilities, Baye's formula, mathematical expectation, law of large numbers, normal approximations, basic limit theorems.
Prerequisite: MATH 22005 or MATH 32051 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 40012   THEORY OF STATISTICS (WIC)   3 Credit Hours
(Slashed with MATH 50012) Sample spaces, continuous distributions, sampling distributions, point and interval estimation, hypothesis testing, types of error, level and power of tests, sequential and nonparametric methods.
Prerequisite: MATH 40011 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Writing Intensive Course

MATH 40015   APPLIED STATISTICS   3 Credit Hours
(Slashed with MATH 50015) Course is based on classical linear regression techniques with an emphasis on real data using the principles of sound data analysis. Close attention is given to issues of interpretation, diagnostics, outliers and influential points, goodness of fit and model selection. Topics include simple and multiple linear regression, transformation and modifications of covariates and responses, design matrices, variable selection and logistic regression. Students with statistics courses from other disciplines should consult with the Department of Mathematical Sciences for possible prerequisite overrides.
Prerequisite: MATH 21001 or MATH 21002 with a minimum C grade; and MATH 12022 with a minimum B grade or MATH 20011 with a minimum C grade or MATH 30011 with a minimum B grade or MATH 40012 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 40024   COMPUTATIONAL STATISTICS   3 Credit Hours
(Slashed with MATH 50024) This course is about the use of computational tools to manage, explore, summarize and visualize data, as well as the computational underpinnings of fitting statistical models. It uses mostly the statistical computation language R, but also other languages like Python and Matlab. It also covers: simulation and random number generation, computationally intensive methods like the bootstrap and permutation tests, Expectation-Maximization and related algorithms and dimensionality reduction via matrix decomposition. Students with statistics courses from other disciplines should consult with the Department of Mathematical Sciences for possible prerequisite overrides.
Prerequisite: MATH 21001 or MATH 21002 with a minimum C grade; and MATH 12022 with a minimum B grade or MATH 20011 with a minimum C grade or MATH 30011 with a minimum B grade or MATH 40012 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 40028   STATISTICAL LEARNING   3 Credit Hours
(Slashed with MATH 50028) This course is about the statistical foundations of modern machine learning techniques. The main focus is classification and prediction using regression-based, tree-based and kernel-based methods. Specific methods include logistic regression, classification and regression trees, random forests and support vector machines. The course also includes an introduction to unsupervised and semi-supervised learning.
Prerequisite: MATH 40015 and MATH 40024 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 40051   TOPICS IN PROBABILITY THEORY AND STOCHASTIC PROCESSES   3 Credit Hours
(Slashed with MATH 50051) Topics from conditional expectations, Markov chains, Markov processes, Brownian motion and Martingales and their applications to stochastic calculus.
Prerequisite: MATH 40011 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 40055   ACTUARIAL MATHEMATICS I (ELR) (WIC)   4 Credit Hours
(Slashed with MATH 50055) Topics from survival models, stochastic analysis of annuities and life insurance and casualty models. .
Prerequisite: MATH 30055 and MATH 40011 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter
Attributes: Experiential Learning Requirement, Writing Intensive Course

MATH 40056   ACTUARIAL MATHEMATICS II   4 Credit Hours
(Slashed with MATH 50056) Benefit premiums, benefit reserves and their analysis, decrement models, joint survivorship, risk models.
Prerequisite: MATH 40055 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 40059   STOCHASTIC ACTUARIAL MODELS   3 Credit Hours
(Slashed with MATH 50059) Topics from investment risk, mean variance analysis, CAPM, financial derivatives, binomial pricing model, stochastic calculus, Black-Scholes pricing model, and Greeks.
Prerequisite: Minimum C grade in MATH 30055 and MATH 40011.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 40093   VARIABLE TITLE WORKSHOP IN MATHEMATICS   1-6 Credit Hours
(Repeatable for credit) Studies special topics in mathematics. Not acceptable for credit toward a major or minor in math without approval of student's adviser.
Prerequisite: Special approval.
Schedule Type: Workshop
Contact Hours: 1-6 other
Grade Mode: Satisfactory/Unsatisfactory

MATH 41001   MODERN ALGEBRA I (ELR) (WIC)   3 Credit Hours
(Slashed with MATH 51001) Basic properties of groups, subgroups, factor groups. Basic properties of rings, integral domains and homomorphisms.
Prerequisite: MATH 22005 or MATH 32051 with a minimum C grade; and MATH 31011 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Experiential Learning Requirement, Writing Intensive Course

MATH 41002   MODERN ALGEBRA II (ELR) (WIC)   3 Credit Hours
(Slashed with MATH 51002) A continuation of MATH 41001, emphasizing properties of rings, their ideals, polynomial ring extensions, fields, finite degree extensions, roots of polynomials, constructability.
Prerequisite: Minimum C grade in MATH 41001.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Experiential Learning Requirement, Writing Intensive Course

MATH 41021   THEORY OF MATRICES   3 Credit Hours
(Slashed with MATH 51021) A rigorous study of the topics introduced in matrix algebra. Topics included are vector space preliminaries, canonical forms of matrices, diagonalizability criteria.
Prerequisite: MATH 21001 and MATH 22005 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 41038   INTERMEDIATE LOGIC   3 Credit Hours
(Slashed with MATH 51038) (Cross-listed with CS 41038 and PHIL 41038 and PHIL 51038) A detailed, systematic study of symbolic logic for philosophy majors, mathematics majors, computer science majors, and anyone else interested in advanced study in logic. The aim of the course is twofold: first, to develop a facility in understanding and using symbolic logic for various purposes, and second, to understand and appreciate symbolic logic as an area of study in itself. Topics include the distinction between syntactic, object-level proofs and semantic, meta-level proofs, the distinction between axiomatic systems and natural deduction systems of object level proofs, various systems of modal logic, and some non-classical logics.
Prerequisite: Junior standing; and Actuarial Mathematics major, Applied Mathematics major, Applied Mathematics minor, Applied Statistics minor, Mathematics (BA or BS) major or Mathematics minor.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 41045   METALOGIC   3 Credit Hours
(Slashed with MATH 51045; Cross-listed with CS 41045 and CS 51045 and PHIL 41045 and PHIL 51045) A detailed, systematic study of metalogic for philosophy majors, mathematics majors, computer science majors, and anyone else interested in advanced study in logic. Topics include the soundness and completeness of the propositional and predicate calculi, the decidablility of propositional calculus, the undecidability of predicate calculus, Gödel's incompleteness proof for languages capable of expressing arithmetic, the co-extensionality of the set of general recursive functions, abacus computable functions, and Turing computable functions, and the philosophical motivations for the ChurchTuring Thesis that all computable functions are Turing computable.
Prerequisite: PHIL 41038.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42001   ANALYSIS I (ELR) (WIC)   3 Credit Hours
(Slashed with MATH 52001) Topics include basic structure of the real numbers, Cauchy sequences, convergence, completeness of the real numbers, continuity, differentiation and Riemann integration.
Prerequisite: MATH 22005 or MATH 32051 with a minimum C grade; and MATH 31011 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Experiential Learning Requirement, Writing Intensive Course

MATH 42002   ANALYSIS II (ELR) (WIC)   3 Credit Hours
(Slashed with MATH 52002) Topics include further development of integration theory, infinite series, uniform convergence, several variable calculus and metric spaces.
Prerequisite: MATH 42001 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
Attributes: Experiential Learning Requirement, Writing Intensive Course

MATH 42011   MATHEMATICAL OPTIMIZATION   3 Credit Hours
(Slashed with MATH 52011) Analytic and numerical techniques for location of extreme points of functions and calculus of variations. Both constrained and unconstrained problems are considered.
Prerequisite: Minimum C grade in MATH 21001 and MATH 22005 or MATH 32051.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42021   GRAPH THEORY AND COMBINATORICS   3 Credit Hours
(Slashed with MATH 52021) Fundamentals and applications of combinatorial mathematics. Topics include traversability, colorability, networks, inclusion and exclusion, matching and designs.
Prerequisite: Minimum C grade in MATH 12003 or MATH 12013; and MATH 21001 or MATH 21002.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42024   NUMBERS AND GAMES   3 Credit Hours
(Slashed with MATH 52024) The study of partisan and impartial combinatorial games, games as numbers and Grundy-Sprague theory.
Prerequisite: Minimum C grade in MATH 21001 or MATH 21002.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42031   MATHEMATICAL MODELS AND DYNAMICAL SYSTEMS   3 Credit Hours
(Slashed with MATH 52031) Formulation and analysis of mathematical models for a variety of phenomena. Mathematical methods from optimization dynamical systems and probability are developed and applied. Modern software tools are utilized.
Prerequisite: MATH 32044 or MATH 32052 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42039   MODELING PROJECTS (ELR) (WIC)   3 Credit Hours
(Slashed with MATH 52039) Individual and small-group projects concerned with the formulation and analysis of mathematical models in a variety of areas. Written and oral reports are required.
Prerequisite: MATH 42031 with a minimum C grade.
Schedule Type: Seminar
Contact Hours: 3 other
Grade Mode: Standard Letter-IP
Attributes: Experiential Learning Requirement, Writing Intensive Course

MATH 42041   ADVANCED CALCULUS   3 Credit Hours
(Slashed with MATH 52041) The calculus and applications of scalar and vector functions of several variables. Vector differential and integral calculus. Applications to field theories, electricity and magnetism and fluid flow.
Prerequisite: MATH 21001 with a minimum C grade; and MATH 22005 or MATH 32051.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42045   PARTIAL DIFFERENTIAL EQUATIONS   3 Credit Hours
(Slashed with MATH 52045) An introduction to Fourier series, Fourier transforms and partial differential equations. Wave, heat and potential equations of mathematical physics. Additional topics include Green's functions and the Method of Characteristics for wave equations.
Prerequisite: MATH 32044 or MATH 32052 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42048   COMPLEX VARIABLES   3 Credit Hours
(Slashed with MATH 52048) Algebra of complex numbers, analytic functions, mappings, Cauchy integral theory, residue theory and applications.
Prerequisite: MATH 22005 or MATH 32051 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42201   NUMERICAL COMPUTING I   3 Credit Hours
(Cross-listed with CS 42201)(Slashed with CS 52201 and MATH 52201) An introduction to numerical methods and software for solving many common scientific computing problems. Linear systems, least-squares data fitting, nonlinear equations and systems and optimization problems.
Prerequisite: Minimum C grade in the following courses: CS 13001 or (CS 13011 and CS 13012); and MATH 12003 or MATH 12013; and MATH 21001 or MATH 21002 or MATH 32051.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 42202   NUMERICAL COMPUTING II   3 Credit Hours
(Cross-listed with CS 42202 and CS 52202) (Slashed with MATH 52202) A continuation of MATH 42201. Topics include interpolation, numerical differentiation and integration, and numerical solution of ordinary differential equations.
Prerequisite: MATH 42201 with a minimum C grade; and MATH 32044 or MATH 32052 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 45011   DIFFERENTIAL GEOMETRY   3 Credit Hours
(Slashed with MATH 55011) Analytic and metric differential geometry of curves and surfaces.
Prerequisite: MATH 22005 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 45021   EUCLIDEAN GEOMETRY   3 Credit Hours
(Slashed with MATH 55021) Geometry of Euclid extended to advanced topics of the triangle, quadrilaterals and circles: cross-ratio, groups, constructions, geometric generalizations and inversion.
Prerequisite: Minimum C grade in MATH 21001 or MATH 21002.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 45022   LINEAR GEOMETRY   3 Credit Hours
(Slashed with MATH 55022) Use of transformations as a tool to study geometry and to differentiate between different kinds of geometry. Linear algebra methods applied to geometry.
Prerequisite: Minimum C grade in MATH 21001 or MATH 21002.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 46001   ELEMENTARY TOPOLOGY   3 Credit Hours
(Slashed with MATH 56001) Metric spaces, introduction to topological spaces, separation axioms.
Prerequisite: MATH 22005 with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 47011   THEORY OF NUMBERS   3 Credit Hours
(Slashed with MATH 57011) Divisibility properties of the integers, prime numbers, congruences, quadratic reciprocity, Diophantine equations, number theoretic functions, simple continued fractions and rational approximations.
Prerequisite: Minimum C grade in MATH 12003 or MATH 12013.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 47021   HISTORY OF MATHEMATICS   3 Credit Hours
(Slashed with MATH 57021) Survey from Babylonian and Egyptian mathematics to 20th century mathematics with emphasis on the development of algebra, geometry, calculus, number theory.
Prerequisite: MATH 23022 or higher with a minimum C grade.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 49992   INTERNSHIP IN MATHEMATICS (ELR)   1-3 Credit Hours
Supervised work experience and training in the mathematical sciences. Since this work will be outside the department a report and final presentation will be required.
Prerequisite: Special Approval.
Schedule Type: Practical Experience
Contact Hours: 0 lecture, 0 lab, 3-9 other
Grade Mode: Satisfactory/Unsatisfactory-IP
Attributes: Experiential Learning Requirement

MATH 49995   SELECTED TOPICS IN MATHEMATICS AND ITS APPLICATIONS   1-4 Credit Hours
(Repeatable for credit) Various special courses will be announced in the schedule of classes under this course number with different section numbers.
Prerequisite: Special approval.
Schedule Type: Lecture
Contact Hours: 1-4 lecture
Grade Mode: Standard Letter

MATH 49996   INDIVIDUAL STUDY   1-4 Credit Hours
(Repeatable for credit) Individual investigation in mathematics.
Prerequisite: Special approval.
Schedule Type: Individual Investigation
Contact Hours: 1-4 other
Grade Mode: Standard Letter

MATH 49998   RESEARCH (ELR)   1-15 Credit Hours
(Repeatable for credit) Research in mathematics.
Prerequisite: Special approval.
Schedule Type: Research
Contact Hours: 1-15 other
Grade Mode: Satisfactory/Unsatisfactory-IP
Attributes: Experiential Learning Requirement

MATH 50011   PROBABILITY THEORY AND APPLICATIONS   3 Credit Hours
(Slashed with MATH 40011) Permutations and combinations, discrete and continuous distributions, random variables, conditional probabilities, Baye's formula, mathematical expectation, law of large numbers, normal approximations, basic limit theorems.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 50012   THEORY OF STATISTICS   3 Credit Hours
(Slashed with MATH 40012) Sample spaces, continuous distributions, sampling distributions, point and interval estimation, hypothesis testing, types of error, level and power of tests, sequential and nonparametric methods.
Prerequisite: MATH 40011 or MATH 50011; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 50015   APPLIED STATISTICS   3 Credit Hours
(Slashed with MATH 40015) Course is based on classical linear regression techniques with an emphasis on real data using the principles of sound data analysis. Close attention is given to issues of interpretation, diagnostics, outliers and influential points, goodness of fit and model selection. Topics include simple and multiple linear regression, transformation and modifications of covariates and responses, design matrices, variable selection and logistic regression.
Prerequisite: Applied Mathematics major or Data Science major or Pure Mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 50024   COMPUTATIONAL STATISTICS   3 Credit Hours
(Slashed with MATH 40024) This course is about the use of computational tools to manage, explore, summarize and visualize data, as well as the computational underpinnings of fitting statistical models. It uses mostly the statistical computation language R, but also other languages like Python and Matlab. It also covers: simulation and random number generation, computationally intensive methods like the bootstrap and permutation tests, Expectation-Maximization and related algorithms and dimensionality reduction via matrix decomposition.
Prerequisite: Applied Mathematics major or Data Science major or Pure Mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 50028   STATISTICAL LEARNING   3 Credit Hours
(Slashed with MATH 40028) This course is about the statistical foundations of modern machine learning techniques. The main focus is classification and prediction using regression-based, tree-based and kernel-based methods. Specific methods include logistic regression, classification and regression trees, random forests and support vector machines. The course also includes an introduction to unsupervised and semi-supervised learning.
Prerequisite: MATH 40015 or MATH 50015; and MATH 40024 or MATH 50024; and Applied Mathematics major or Data Science major or Pure Mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 50051   TOPICS IN PROBABILITY THEORY AND STOCHASTIC PROCESSES   3 Credit Hours
(Slashed with MATH 40051) Topics from conditional expectations, Markov chains, Markov processes, Brownian Motion and Martingales and their applications to stochastic calculus.
Prerequisite: MATH 50011; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 50055   ACTUARIAL MATHEMATICS I   4 Credit Hours
(Slashed with MATH 40055) Topics from survival models, stochastic analysis of annuities and life insurance and casualty models.
Prerequisite: MATH 30055 and MATH 50011; and graduate standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 50056   ACTUARIAL MATHEMATICS II   4 Credit Hours
(Slashed with MATH 40056) Benefit premiums, benefit reserves and their analysis; decrement models, joint survivorship, risk models.
Prerequisite: MATH 50055; and graduate standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 50059   STOCHASTIC ACTUARIAL MODELS   3 Credit Hours
(Slashed with MATH 40059) Topics from investment risk, mean variance analysis, CAPM, financial derivatives, binomial pricing model, stochastic calculus, Black-Scholes pricing model, and Greeks.
Prerequisite: MATH 40011 or 50011 and Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 51001   MODERN ALGEBRA I   3 Credit Hours
(Slashed with MATH 41001) Basic properties of groups, subgroups, factor groups. Basic properties of rings, integral domains and homomorphisms.
Prerequisite: MATH 21001 and MATH 22005; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 51002   MODERN ALGEBRA II   3 Credit Hours
(Slashed with MATH 41002) A continuation of MATH 51001, emphasizing properties of rings, their ideals, polynomial ring extensions, fields, finite degree extensions, roots of polynomials, constructibility.
Prerequisite: MATH 41001 or MATH 51001; and applied mathematics or pure mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 51021   THEORY OF MATRICES   3 Credit Hours
(Slashed with MATH 41021) A rigorous study of the topics introduced in matrix algebra. Topics included are: canonical forms of matrices, diagonalizability criteria.
Prerequisite: MATH 21001 and MATH 22005; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 51038   INTERMEDIATE LOGIC   3 Credit Hours
(Cross-listed with PHIL 51038)(Slashed with CS 41038, MATH 41038 and PHIL 41038) A detailed, systematic study of symbolic logic for philosophy majors, mathematics majors, computer science majors, and anyone else interested in advanced study in logic. The aim of the course is twofold: first, to develop a facility in understanding and using symbolic logic for various purposes, and second, to understand and appreciate symbolic logic as an area of study in itself. Topics include the distinction between syntactic, object-level proofs and semantic, meta-level proofs, the distinction between axiomatic systems and natural deduction systems of object-level proofs, various systems of modal logic and some non-classical logics.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 51045   METALOGIC   3 Credit Hours
(Cross-listed with CS 41045 and CS 51045 and PHIL 41045 and PHIL 51045) (Slashed with MATH 41045) A detailed, systematic study of metalogic for philosophy majors, mathematics majors, computer science majors, and anyone else interested in advanced study in logic. Topics include the soundness and completeness of the propositional and predicate calculi, the decidablility of propositional calculus, the undecidability of predicate calculus, Gödel's incompleteness proof for languages capable of expressing arithmetic, the co-extensionality of the set of general recursive functions, abacus computable functions, and Turing computable functions, and the philosophical motivations for the ChurchTuring Thesis that all computable functions are Turing computable
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52001   ANALYSIS I   3 Credit Hours
(Slashed with MATH 42001) Topics include basic structure of the real numbers, Cauchy sequences, convergence, completeness of the real numbers ,continuity, differentiation and Riemann integration.
Prerequisite: Applied mathematics or pure mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52002   ANALYSIS II   3 Credit Hours
(Slashed with MATH 42002) Topics include further development of integration theory infinite series, uniform convergence, several variable calculus and metric spaces.
Prerequisite: MATH 42001 or MATH 52001; and applied mathematics or pure mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52011   MATHEMATICAL OPTIMIZATION   3 Credit Hours
(Slashed with MATH 42011) Analytical and numerical techniques for location of extreme points of functions and calculus of variations. Both constrained and unconstrained problems are considered.
Prerequisite: MATH 21001 and MATH 22005; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52021   GRAPH THEORY AND COMBINATORICS   3 Credit Hours
(Slashed with MATH 42021) Fundamentals and applications of combinatorial mathematics. Topics include transversability, colorability, networks, inclusion and exclusion, matching and designs.
Prerequisite: MATH 12003 and MATH 21001; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52024   NUMBERS AND GAMES   3 Credit Hours
(Slashed with MATH 42024) The study of partisan and impartial combinatorial games, games as numbers and Grundy-Sprague theory.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52031   MATHEMATICAL MODELS AND DYNAMICAL SYSTEMS   3 Credit Hours
(Slashed with MATH 42031) Formulation and analysis of mathematical models for a variety of phenomena. Mathematical methods from optimization, dynamical systems and probability are developed and applied. Modern software tools are utilized.
Prerequisite: MATH 32044; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52039   MODELING PROJECTS   3 Credit Hours
(Slashed with MATH 42039) Individual and small-group projects concerned with the formulation and analysis of mathematical models in a variety of areas. Written and oral reports required.
Prerequisite: MATH 52031 with a minimum C grade; and graduate standing.
Schedule Type: Seminar
Contact Hours: 3 other
Grade Mode: Standard Letter

MATH 52041   ADVANCED CALCULUS   3 Credit Hours
(Slashed with MATH 42041) The calculus and applications of scalar and vector functions of several variables. Vector differential and integral calculus. Applications to field theories, electricity and magnetism and fluid flow.
Prerequisite: MATH 21001 and MATH 22005.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52045   PARTIAL DIFFERENTIAL EQUATIONS   3 Credit Hours
(Slashed with MATH 42045) Introduction to Fourier series, Fourier transforms and partial differential equations. Wave, heat and potential equations of mathematical physics. Additional topics include Green's functions and the Method of Characteristics for wave equations.
Prerequisite: Applied mathematics or pure mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52048   COMPLEX VARIABLES   3 Credit Hours
(Slashed with MATH 42048) Algebra of complex numbers, analytic functions, mappings, Cauchy integral theory, residue theory and applications.
Prerequisite: Applied mathematics or pure mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52201   NUMERICAL COMPUTING I   3 Credit Hours
(Cross-listed with CS 52201) (Slashed with CS 42201 and MATH 42201) An introduction to numerical methods and software for solving many common scientific computing problems. Linear systems, least-squares data fitting, nonlinear equations and systems and optimization problems.
Prerequisite: Applied Mathematics or Pure Mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 52202   NUMERICAL COMPUTING II   3 Credit Hours
(Cross-listed with CS 42202 and CS 52202) (Slashed with MATH 42202) A continuation of MATH 52201. Topics include interpolation, numerical differentiation and integration, and numerical solution of ordinary differential equations.
Prerequisite: MATH 42201 or 52201; and applied mathematics or pure mathematics major; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 55011   DIFFERENTIAL GEOMETRY   3 Credit Hours
(Slashed with MATH 45011) Analytic and metric differential geometry of curves and surfaces.
Prerequisite: MATH 22005; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 55021   EUCLIDEAN GEOMETRY   3 Credit Hours
(Slashed with MATH 45021) Geometry of Euclid extended to advanced topics of the triangle, quadrilaterals and circles: cross-ratio, groups, constructions, geometric generalizations and inversion.
Prerequisite: MATH 21001; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 55022   LINEAR GEOMETRY   3 Credit Hours
(Slashed with MATH 45022) Use of transformations as a tool to study geometry and to differentiate between different kinds of geometry. Linear algebra methods applied to geometry.
Prerequisite: MATH 21001; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 56001   ELEMENTARY TOPOLOGY   3 Credit Hours
(Slashed with MATH 46001) Metric spaces, introduction to topological spaces, separation axioms.
Prerequisite: MATH 22005; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 57011   THEORY OF NUMBERS   3 Credit Hours
(Slashed with MATH 47011) Divisibility properties of the integers, prime numbers, congruences, quadratic reciprocity, Diophantine equations, number theoretic functions, simple continued fractions and rational approximations.
Prerequisite: MATH 12003; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 57021   HISTORY OF MATHEMATICS   3 Credit Hours
(Slashed with MATH 47021) Survey from Babylonian and Egyptian mathematics to 20th-century mathematics with emphasis on the development of algebra, geometry, calculus, number theory.
Prerequisite: One course MATH 23022 or higher; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 57057   ADVANCED CONCEPTS OF GEOMETRY   3 Credit Hours
The course covers advanced topics in Euclidean Geometry, including Ceva's, Menelaus', and the Nine-Point Theorems, Mass-point Geometry, Solid Geometry, 2D and 3D Analytic Geometry, Conic Sections, Geometric Inequalities, Applications of Complex numbers in Euclidean Geometry, Geometric Constructions, and Combinatorial Geometry.
Prerequisite: Graduate standing and special approval.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 57067   ADVANCED CONCEPTS OF PROBABILITY AND STATISTICS   3 Credit Hours
The course covers advanced topics in probability and statistics, including core probability topics: probability axioms, discrete and continuous random variables, independence and conditional probability, inequalities and Limit Theorems; together with main statistics topics sample, sample mean and variance, interval estimators, hypothesis tests and linear regression.
Prerequisite: Graduate standing and special approval.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 57077   ADVANCED CONCEPTS OF ALGEBRA   3 Credit Hours
The course covers advanced topics in Abstract Algebra, including basic number theory, divisibility and congruence of integers, examples and properties of rings, polynomial rings, unique factorization and irreducibility of polynomials, quotient rings, finite fields, examples and basic properties of groups, Cayley tables and isomorphisms, subgroups, cosets, and the theorems of Lagrange, Euler, and Fermat.
Prerequisite: Graduate standing and special approval.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 57095   SPECIAL TOPICS: MATHEMATICS AND ITS APPLICATIONS   1-3 Credit Hours
(Repeatable for credit) Offered periodically with different topics and different faculty involved.
Prerequisite: Graduate standing or special approval.
Schedule Type: Lecture
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 59893   VARIABLE TITLE WORKSHOP IN MATHEMATICS   1-6 Credit Hours
(Repeatable for credit) Studies in special topics in pure and applied mathematics.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Workshop
Contact Hours: 1-6 other
Grade Mode: Satisfactory/Unsatisfactory

MATH 60051   PROBABILITY I   4 Credit Hours
(Slashed with MATH 70051) Distribution functions, measure theory, random variables, expectation, independence, convergence, concepts, law of large numbers.
Prerequisite: MATH 40011 or MATH 42002 or MATH 50011 or MATH 52002; and graduate standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 60052   PROBABILITY II   3 Credit Hours
(Slashed with MATH 70052) Characteristic functions, the central limit problem, conditional expectations, Martingale theory, Brownian motion.
Prerequisite: MATH 60051; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 60061   MATHEMATICAL STATISTICS I   4 Credit Hours
(Slashed with MATH 70061) Statistics, distributions of statistics. Sampling distributions. Decision spaces and loss functions. Sufficiency and completeness. Estimation theory. Rao Blackwell and the Cramer Rao theorems.
Prerequisite: MATH 42002 or MATH 52002; and graduate standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 60062   MATHEMATICAL STATISTICS II   3 Credit Hours
(Slashed with MATH 70062) Tests of statistical hypothesis. Neyman Pearson Lemma. Exponential families and invariance. Sequential tests. Non-parametric procedures.
Prerequisite: MATH 60061; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 60070   FINANCIAL MATHEMATICS   3 Credit Hours
(Slashed with MATH 70070) Topics from replication of trading strategies, arbitrage, completeness, Martingale representation theorem, fundamental theorem of finance, stochastic differential equations, Black and Scholes formula of option pricing.
Prerequisite: MATH 50051; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 60091   SEMINAR IN STATISTICS AND PROBABILITY   1-3 Credit Hours
(Repeatable for credit) Seminar on current research in statistics and probability.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 60093   VARIABLE TITLE WORKSHOP IN MATHEMATICS   1-3 Credit Hours
(Repeatable for credit) Studies of special topics in mathematics. Not acceptable for credit toward a graduate degree in mathematics without approval of the student's adviser.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Workshop
Contact Hours: 1-3 other
Grade Mode: Satisfactory/Unsatisfactory

MATH 60194   COLLEGE TEACHING OF MATHEMATICS--LAB   1 Credit Hour
Techniques and problems in the teaching of college-level mathematics. Student presentations of mathematical papers and colloquia will be included.
Prerequisite: Graduate standing.
Schedule Type: Combined Lecture and Lab
Contact Hours: 0 lecture, 2 lab, 0 other
Grade Mode: Standard Letter

MATH 61051   ABSTRACT ALGEBRA I   4 Credit Hours
(Slashed with MATH 71051) Advanced topics in group theory including Sylow Theorems, finite Abelian groups, divisible groups and related concepts. Includes one hour problem session each week.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 61052   ABSTRACT ALGEBRA II   3 Credit Hours
(Slashed with MATH 71052) Advanced topics, commutative ring theory and field theory, including polynomial rings, unique factorization domains, matrix rings, Galois theory.
Prerequisite: MATH 61051; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 61091   SEMINAR IN ALGEBRA   1-3 Credit Hours
(Repeatable for credit) Seminar on current research in algebra.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Satisfactory/Unsatisfactory

MATH 62041   METHODS OF APPLIED MATHEMATICS I   3 Credit Hours
(Slashed with MATH 72041) Analysis and applications of ordinary and partial differential equations and related topics. Dimensional analysis (Buckingham Pi Theorem). Perturbation methods (singular perturbations, matched asymptotic expansions, WKB approximation). Variational methods (Euler-Lagrange equations).
Prerequisite: MATH 51021 and MATH 52041 and MATH 52045 and MATH 52048; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62042   METHODS OF APPLIED MATHEMATICS II   3 Credit Hours
(Slashed with MATH 72042) Continuation of MATH 62041. Integral equations and Green's functions (Fredholm alternative, compact operators, distributions, weak solutions). Wave phenomena (dispersion, KdV equation). Stability and bifurcation (linearized stability analysis, turning points, Hopf bifurcation).
Prerequisite: MATH 62041; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62051   FUNCTIONS OF A REAL VARIABLE I   4 Credit Hours
(Slashed with MATH 72051) Introduction to modern concepts of real analysis, including metric spaces, measure and integration theory.
Prerequisite: MATH 42002 or MATH 52002; and graduate standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 62052   FUNCTIONS OF A REAL VARIABLE II   3 Credit Hours
(Slashed with MATH 72052) A continuation of MATH 62051. Included are basic topics in functional analysis and Hilbert space theory.
Prerequisite: MATH 62051; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62151   FUNCTIONS OF A COMPLEX VARIABLE I   4 Credit Hours
(Slashed with MATH 72151) Topological properties of the complex plane; analytic, entire, meromorphic functions; analytic continuation; conformal mappings; Picard's Theorem; Riemann surfaces.
Prerequisite: MATH 52002; and graduate standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 62152   FUNCTIONS OF A COMPLEX VARIABLE II   3 Credit Hours
(Slashed with MATH 72152) Topological properties of the complex plane; analytic, entire, meromorphic functions; analytic continuation; conformal mappings; Picard's Theorem; Riemann surfaces.
Prerequisite: MATH 62151; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62203   COMPUTATIONAL FINANCE   3 Credit Hours
(Slashed with MATH 72203) Basic numerical methods, (numerical linear algebra, nonlinear equations, curve fitting, ODEs, integration, Monte-Carlo methods), numerical solution of PDEs (stability, convergence, Black-Scholes, American options, SDEs) probabilistic methods.
Prerequisite: MATH 22005 and MATH 21001 and MATH 32044; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62251   NUMERICAL ANALYSIS I   4 Credit Hours
(Slashed with MATH 72251) Floating point computation, rounding error analysis, conditioning, interpolation (polynomial, trigonometric, spline). Numerical quadrature (Newton-Cotes, Gauss),extrapolation, Romberg integration.
Prerequisite: MATH 42002 or MATH 52002; and graduate standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 62252   NUMERICAL ANALYSIS II   3 Credit Hours
(Slashed with MATH 72252) Numerical solution of linear systems of equations (LU factorization, error analysis). Least squares, orthogonalization methods. Algebraic eigenvalue problems, QR algorithm, singular value decomposition.
Prerequisite: MATH 41021 or MATH 51021; and MATH 62251 or MATH 72251; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62261   NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS   3 Credit Hours
(Slashed with MATH 72261) Discretization methods for ordinary differential equations and systems. Initial value and boundary value problems. Numerical implementation software and analysis.
Prerequisite: MATH 32044; and MATH 42202 or MATH 52202; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62262   NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS   3 Credit Hours
(Slashed with MATH 72262) Derivation and analysis of discrete methods (finite differences, finite elements) for the numerical solution of elliptic, hyperbolic and parabolic partial differential equations.
Prerequisite: MATH 42045 or MATH 52045; and MATH 42202 or MATH 52202; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62263   NUMERICAL SOLUTION OF LARGE SPARSE LINEAR SYSTEMS   3 Credit Hours
(Slashed with MATH 72263) (Cross-listed with CS 62263 and CS 72263) Construction and analysis of iterative methods for large systems of linear algebraic equations. Jacobi, Gauss-Seidel, SOR. Polynomial acceleration methods, conjugate gradients. Multi-grid methods.
Prerequisite: MATH 41021 or MATH 51021; and MATH 42202 or MATH 52202; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62264   NUMERICAL SOLUTION OF NONLINEAR SYSTEMS   3 Credit Hours
(Cross-listed with CS 62264 and CS 72264) (Slashed with MATH 72264) Construction and analysis of numerical methods for systems of nonlinear algebraic equations and optimization problems. Numerical implementation and software.
Prerequisite: MATH 42041 or MATH 52041; and MATH 42202 or MATH 52202; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 62291   SEMINAR IN COMPUTATIONAL AND APPLIED MATHEMATICS   1-3 Credit Hours
(Repeatable for credit) (Slashed with MATH 72291) Seminar on current research in computational and applied Mathematics
Prerequisite: Graduate standing; and special approval.
Schedule Type: Seminar
Contact Hours: 3 other
Grade Mode: Standard Letter

MATH 62391   SEMINAR IN MEASURE THEORY   1-3 Credit Hours
(Repeatable for credit) Seminar on current research in measure theory.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 62491   SEMINAR IN NONLINEAR ANALYSIS   1-3 Credit Hours
(Repeatable for credit) Seminar on current research in nonlinear analysis.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 64091   SEMINAR IN MATHEMATICS EDUCATION   3 Credit Hours
(Repeatable for credit) Studies in geometry, algebra, mathematics for junior and senior high school. Mathematics content professionalized for teachers.
Prerequisite: MATH 34001; and graduate standing.
Schedule Type: Seminar
Contact Hours: 3 other
Grade Mode: Standard Letter

MATH 66051   INTRODUCTION TO TOPOLOGY I   4 Credit Hours
(Slashed with MATH 76051) Set theory, topological spaces, continuity, product spaces, quotient spaces, separation axioms, compactness and metrizability.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 67091   SEMINAR IN NUMBER THEORY   1-3 Credit Hours
(Repeatable for credit) (Slashed with MATH 77091) Seminar on current research in number theory.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 67095   SELECTED TOPICS IN MATHEMATICS   1-4 Credit Hours
(Repeatable for credit) Various special courses will be announced in the schedule of classes under this course number with different section numbers.
Prerequisite: Graduate standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-4 lecture, 0 lab, 0 other
Grade Mode: Standard Letter

MATH 67098   RESEARCH   1-15 Credit Hours
(Repeatable for credit) Research or individual investigation. Credits are applied toward degree requirements with approval if letter grade of "S" is given.
Prerequisite: Graduate standing.
Schedule Type: Research
Contact Hours: 1-15 other
Grade Mode: Standard Letter

MATH 67199   THESIS I   2-6 Credit Hours
Thesis student must register for a total of 6 hours, 2 to 6 hours in a single semester distributed over several semesters if desired.
Prerequisite: Graduate standing.
Schedule Type: Masters Thesis
Contact Hours: 2-6 other
Grade Mode: Satisfactory/Unsatisfactory-IP

MATH 67299   THESIS II   2 Credit Hours
Thesis students must continue registration each semester until all degree requirements are met.
Prerequisite: MATH 67199; and graduate standing.
Schedule Type: Masters Thesis
Contact Hours: 2 other
Grade Mode: Satisfactory/Unsatisfactory-IP

MATH 69099   CAPSTONE PROJECT   2-3 Credit Hours
The course is an integrative experience that brings together all components of the Masters nonthesis graduate program.
Prerequisite: Graduate standing and special approval.
Schedule Type: Project or Capstone
Contact Hours: 0 lecture, 0 lab, 2-3 other
Grade Mode: Standard Letter-IP

MATH 70051   PROBABILITY I   4 Credit Hours
(Slashed with MATH 60051) Distribution functions, measure theory, random variables, expectation, independence, convergence, concepts, law of large numbers.
Prerequisite: MATH 40011 or MATH 50011; or MATH 42002 or MATH 52002; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 70052   PROBABILITY II   3 Credit Hours
(Slashed with MATH 60052) Characteristic functions, the central limit problem, conditional expectations, Martingale theory, Brownian motion.
Prerequisite: MATH 60051 or MATH 70051; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 70061   MATHEMATICAL STATISTICS I   4 Credit Hours
(Slashed with MATH 60061) Statistics, distributions of statistics. Sampling distributions. Decision spaces and loss functions. Sufficiency and completeness. Estimation theory. Rao Blackwell and the Cramer Rao theorems.
Prerequisite: MATH 42002 or MATH 52002.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 70062   MATHEMATICAL STATISTICS II   3 Credit Hours
(Slashed with MATH 60062) Tests of statistical hypothesis. Neyman Pearson Lemma. Exponential families and invariance. Sequential tests. Non parametric procedures.
Prerequisite: MATH 60061 or MATH 70061; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 70070   FINANCIAL MATHEMATICS   3 Credit Hours
(Slashed with MATH 60070) Topics from replication of trading strategies, arbitrage completeness, Martingale presentation theorem, fundamental theorem of finance, stochastic differential equations, Black and Scholes formula of option pricing.
Prerequisite: MATH 50051; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 70091   SEMINAR IN STATISTICS AND PROBABILITY   1-3 Credit Hours
(Repeatable for credit) Seminar on current research in statistics and probability.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Seminar
Contact Hours: 3 other
Grade Mode: Standard Letter

MATH 70094   COLLEGE TEACHING OF MATHEMATICS   1 Credit Hour
(Repeatable for credit) Techniques and problems in the teaching of college-level mathematics. Student presentations of mathematical papers and colloquia will be included.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 1 lecture
Grade Mode: Standard Letter

MATH 70095   SELECTED TOPICS IN STATISTICS AND PROBABILITY 1-3 Credit Hours
(Repeatable for credit) Topics vary with each offering and complement topics covered in MATH 70051, MATH 70052, MATH 70061 and MATH 70062.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 70194   COLLEGE TEACHING OF MATHEMATICS--LAB   1 Credit Hour
Techniques and problems in the teaching of college-level mathematics. Student presentations of mathematical papers and colloquia will be included.
Prerequisite: Graduate standing.
Schedule Type: Combined Lecture and Lab
Contact Hours: 0 lecture, 2 lab, 0 other
Grade Mode: Standard Letter

MATH 71001   STRUCTURE OF RINGS AND ALGEBRAS I   3 Credit Hours
Advanced topics in ring theory, including Artinian rings, Noetherian rings, advanced commutative ring theory.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 71002   STRUCTURE OF RINGS AND ALGEBRAS II   3 Credit Hours
Advanced topics in ring theory including an introduction to homological algebra. Includes Dedekind domains, regular rings, torsion theory.
Prerequisite: MATH 71001; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 71011   ADVANCED GROUP THEORY   3 Credit Hours
Advanced topics in group theory. Topics include permutation arguments, coprime actions, transfer theorems, nonsimplicity criteria. Properties of families of groups: solvable, p solvable, nilpotent, p groups.
Prerequisite: MATH 61051 or MATH 71051; and MATH 61052 or MATH 71052; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 71012   CHARACTERS OF FINITE GROUPS   3 Credit Hours
Development of characters of finite groups, their properties, orthogonality relations, integrality conditions. Applications include Burnside's paqb theorem and existence of Frobenius kernels in Frobenius groups.
Prerequisite: MATH 61051 or MATH 71051; and MATH 61052 or MATH 71052; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 71051   ABSTRACT ALGEBRA I   4 Credit Hours
(Slashed with MATH 61051) Advanced topics in group theory, including Sylow theorems, finite Abelian groups, divisible groups and related concepts. Includes one-hour problem session each week.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 71052   ABSTRACT ALGEBRA II   3 Credit Hours
(Slashed with MATH 61052) Advanced topics, commutative ring theory and field theory, including polynomial rings, unique factorization, domains, matrix rings, Galois theory.
Prerequisite: MATH 61051 or MATH 71051; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 71091   SEMINAR IN ALGEBRA   1-3 Credit Hours
(Repeatable for credit) (Slashed with MATH 61091) Seminar on current research in algebra.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Satisfactory/Unsatisfactory

MATH 71095   SELECTED TOPICS IN ALGEBRA   1-3 Credit Hours
(Repeatable for credit) Topics vary with each offering and complement topics covered in MATH 71002, MATH 71051 and MATH 71052.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 72001   FUNCTIONAL ANALYSIS I   3 Credit Hours
A study of principles of linear analysis in the setting of normed linear spaces and topological vector spaces.
Prerequisite: MATH 72052; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72041   METHODS OF APPLIED MATHEMATICS I   3 Credit Hours
(Slashed with MATH 62041) Analysis and applications of ordinary and partial differential equations and related topics. Dimensional analysis (Buckingham Pi Theorem). Perturbation methods (singular perturbations, matched asymptotic expansions, WKB approximation). Variational methods (Euler-Lagrange equations).
Prerequisite: MATH 51021 and MATH 52041 and MATH 52045 and MATH 52048; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72042   METHODS OF APPLIED MATHEMATICS II   3 Credit Hours
(Slashed with MATH 62042) Continuation of MATH 72041. Integral equations and Green's functions (Fredholm alternative, compact operators, distributions, weak solutions). Wave phenomena (dispersion, KdV equation). Stability and bifurcation (linearized stability analysis, turning points, Hopf bifurcation).
Prerequisite: MATH 62041 or MATH 72041; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72051   FUNCTIONS OF A REAL VARIABLE I   4 Credit Hours
(Slashed with MATH 62051) Introduction to modern concepts of real analysis including metric spaces, measure and integration theory.
Prerequisite: MATH 42002 or MATH 52002; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 72052   FUNCTIONS OF A REAL VARIABLE II   3 Credit Hours
(Slashed with MATH 62052). A continuation of MATH 72051. Included are basic topics in functional analysis and Hilbert space theory.
Prerequisite: MATH 62051 or MATH 72051; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72095   SELECTED TOPICS IN REAL ANALYSIS   1-3 Credit Hours
(Repeatable for credit) Topics vary with each offering and complement topics covered in MATH 72002, MATH 72051 and MATH 72052.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 72151   FUNCTIONS OF A COMPLEX VARIABLE I   4 Credit Hours
(Slashed with MATH 62151) Topological properties of the complex plane; analytic, entire, meromorphic functions; analytic continuation; conformal mappings; Picard's Theorem; Riemann surfaces.
Prerequisite: MATH 52002; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 72152   FUNCTIONS OF A COMPLEX VARIABLE II   3 Credit Hours
(Slashed with MATH 62152) Topological properties of the complex plane; analytic, entire, meromorphic functions; analytic continuation; conformal mappings; Picard's theorem; Riemann surfaces.
Prerequisite: MATH 72151; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72195   SELECTED TOPICS IN COMPLEX ANALYSIS   1-3 Credit Hours
(Repeatable for credit) Topics vary with each offering and complement topics covered in MATH 72151 and MATH 72152.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 72203   COMPUTATIONAL FINANCE   3 Credit Hours
(Slashed with MATH 62203) Basic numerical methods, (numerical linear algebra, nonlinear equations, curve fitting, ODEs, integration, Monte-Carlo methods) numerical solution of PDEs (stability, convergence, Black-Scholes, American options, SDEs) probabilistic methods.
Prerequisite: MATH 22005 and MATH 21001 and MATH 32044; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72251   NUMERICAL ANALYSIS I   4 Credit Hours
(Slashed with MATH 62251) Floating point computation, rounding error analysis, conditioning, interpolation (polynomial, trigonometric spline). Numerical quadrature (Newton-Cotes, Gauss), extrapolation, Romberg integration.
Prerequisite: MATH 42002 or MATH 52002; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 72252   NUMERICAL ANALYSIS II   3 Credit Hours
(Slashed with MATH 62252) Numerical solution of linear systems of equations (LU factorization, error analysis). Least squares, orthogonalization methods. Algebraic eigenvalue problems, QR algorithm, singular value decomposition.
Prerequisite: MATH 41021 or MATH 51021; and MATH 62251 or MATH 72251; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72261   NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS   3 Credit Hours
(Slashed with MATH 62261) Discretization methods for ordinary differential equations and systems. Initial value and boundary value problems. Numerical implementation software and analysis.
Prerequisite: MATH 32044; and MATH 42202 or MATH 52202; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72262   NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS   3 Credit Hours
(Slashed with MATH 62262) Derivation and analysis of discrete methods (finite differences, finite elements) for the numerical solution of elliptic, hyperbolic and parabolic partial differential equations.
Prerequisite: MATH 42045 or MATH 52045; and MATH 42202 or MATH 52202; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72263   NUMERICAL SOLUTION OF LARGE SPARSE LINEAR SYSTEMS   3 Credit Hours
(Slashed with MATH 62263) (Cross-listed with CS 62263 and CS 72263) Construction and analysis of iterative methods for large systems of linear algebraic equations. Jacobi, Gauss-Seidel, SOR. Polynomial acceleration methods, conjugate gradients. Multi-grid methods.
Prerequisite: MATH 41021 or MATH 51021; and MATH 42202 or MATH 52202; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72264   NUMERICAL SOLUTION OF NONLINEAR SYSTEMS   3 Credit Hours
(Slashed with MATH 62264) (Cross-listed with CS 62264 and CS 72264) Construction and analysis of numerical methods for systems of nonlinear algebraic equations and optimization problems. Numerical implementation and software.
Prerequisite: MATH 42041 or MATH 52041; and MATH 42202 or MATH 52202; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 72291   SEMINAR IN COMPUTATIONAL AND APPLIED MATHEMATICS   1-3 Credit Hours
(Repeatable for credit) (Slashed with Math 62291) Seminar on current research in numerical analysis.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 72295   SELECTED TOPICS IN NUMERICAL ANALYSIS   1-3 Credit Hours
(Repeatable for credit) Topics vary with each offering and complement topics covered in MATH 72251 and MATH 72252.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 72391   SEMINAR IN MEASURE THEORY   1-3 Credit Hours
(Repeatable for credit) Seminar on current research in measure theory.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 72491   SEMINAR IN NONLINEAR ANALYSIS   1-3 Credit Hours
(Repeatable for credit) Seminar on current research in nonlinear analysis.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 76051   INTRODUCTION TO TOPOLOGY I   4 Credit Hours
(Slashed with MATH 66051) Set theory, topological spaces, continuity, product spaces, quotient spaces separation axioms, compactness and metrizability.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 4 lecture
Grade Mode: Standard Letter

MATH 76095   SELECTED TOPICS IN TOPOLOGY   1-3 Credit Hours
(Repeatable for credit) Topics vary with each offering and complement topics covered in MATH 76051.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 77011   ALGEBRAIC NUMBER THEORY   3 Credit Hours
Number fields and Dedekind domains; conjugates, norm and trace, discriminant, integral bases; arithmetic or quadraic and cyclotomic number fields; theory of ideals and class group; Dirichlet's thoerem on units.
Prerequisite: MATH 57011; and MATH 61052 or MATH 71052; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 77012   ANALYTIC NUMBER THEORY   3 Credit Hours
Multiplicative functions and summatory functions, Riemann's Zeta function and the prime number theorem, L-functions and Dirichlet's theorem on prtithmetic progressions, asymptotic formula for partitions.
Prerequisite: MATH 57011 and MATH 62151 or MATH 72151.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

MATH 77091   SEMINAR IN NUMBER THEORY   1-3 Credit Hours
(Repeatable for credit) (Slashed with MATH 67091) Seminar on current research in number theory.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Seminar
Contact Hours: 1-3 other
Grade Mode: Standard Letter

MATH 77095   SELECTED TOPICS IN MATHEMATICS   1-3 Credit Hours
(Repeatable for credit) Course topic varies with each offering.
Prerequisite: Special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 77098   RESEARCH I   1-15 Credit Hours
(Repeatable for credit) Research or individual investigation. Credits are applied toward degree requirements with approval if letter grade of "S" is given.
Prerequisite: Doctoral standing.
Schedule Type: Research
Contact Hours: 1-15 other
Grade Mode: Standard Letter

MATH 77195   SELECTED TOPICS IN NUMBER THEORY   1-3 Credit Hours
(Repeatable for credit) Content varies with each offering and complements topics covered in MATH 77011 and MATH 77012.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

MATH 77198   RESEARCH II   1-15 Credit Hours
(Repeatable for credit) Research or individual investigation. Credits are applied toward degree requirements with approval if letter grade of "S" is given.
Prerequisite: Doctoral standing.
Schedule Type: Research
Contact Hours: 1-15 other
Grade Mode: Satisfactory/Unsatisfactory

MATH 87098   RESEARCH   1-15 Credit Hours
(Repeatable for credit) Research or individual investigation for doctoral students who have not yet passed their candidacy examinations. Credits earned may be applied toward degree if department approves.
Prerequisite: Doctoral standing.
Schedule Type: Research
Contact Hours: 1-15 other
Grade Mode: Standard Letter

MATH 87199   DISSERTATION I   15 Credit Hours
(Repeatable for credit) Doctoral dissertation, for which registration in at least two semesters is required first of which will be semester in which dissertation work is begun and continuing until the completion of 30 hours.
Prerequisite: Admission to doctoral candidacy; and doctoral standing.
Schedule Type: Dissertation
Contact Hours: 15 other
Grade Mode: Satisfactory/Unsatisfactory-IP

MATH 87299   DISSERTATION II   15 Credit Hours
(Repeatable for credit) Continuing registration required of doctoral students who have completed the initial 30 hours of dissertation and continuing until all degree requirements are met.
Prerequisite: MATH 87199; and doctoral standing.
Schedule Type: Dissertation
Contact Hours: 15 other
Grade Mode: Satisfactory/Unsatisfactory-IP