Graduate Courses

The following courses are available to those preparing for degree language examinations or for improvement in reading ability:

FREN505	**(5)**
Reading French
For students without a working knowledge in French; an introduction to the grammar and syntax of French for the purpose of translating written French into English. May count toward a general elective only.

GRMN505	**(5)**
Reading German
For students without a working knowledge in German; an introduction to the grammar and syntax of German for the purpose of translating written German into English. May count toward a general elective only.

INLS575	**(1–3)**
Topics in _____
A study of selected topics in language, literature, or civilization. Topics and credits to be announced. Repeatable with different topics.

INLS590	**(1–3)**
Directed Study/Reading/Research/Project
Studies in the area of French/Spanish language, literature, or civilization, as determined in consultation with the instructor.

MATHEMATICS

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Lecturers
Keith G. Calkins
Shirleen Luttrell

Emeriti
Kenneth L. Franz
Theodore R. Hatcher
Donald H. Rhoads
Edward J. Specht

Academic Programs	Credits
BS: Mathematics	39
Applied Mathematics	
Preparation for Secondary School Mathematics Teaching	
Preparation for Graduate Study in Mathematics	
BS: Mathematics Education	30
Major in Mathematical Studies	30
Minor in Mathematics	20
Minor in Mathematics Education	20
Minor in Mathematics of Economics and Finance	20

Mathematics is foundational to physics, engineering, and computer science, and is increasingly important in many fields of study such as finance, accounting, economics, biology, medicine, and environmental science. Students majoring in these and other fields will find that acquiring an additional major in mathematics or mathematical studies greatly enhances the marketability of their degree.

Undergraduate Programs

BS: Mathematics—39

MATH141, 142, 215, 240, 286, 315, 355; STAT340 and at least 12 credits in additional courses chosen in consultation with a Mathematics Department advisor from MATH271, 389, 405, 408, 426, 431, 432, 441, 442, 475, 487, 495, CPTR436. Students in a teacher certification program are required to take MATH475. A major field test in mathematics is required during the senior year.
Cognate Course: CPTR125

Major in Mathematical Studies—30

MATH141, 142, 215, 240 and at least 15 credits in additional courses chosen in consultation with a Mathematics Department advisor from STAT340, CPTR125, MATH271, 286, 315, 355, 389, 405, 408, 426, 431, 432, 441, 442, 475, 487, 495, CPTR436. A major field test in mathematics is required during the senior year. This major is available only as a second major, to those taking a major in another field.

Minor in Mathematics—20

MATH141, 142, 215 and at least 9 credits in additional courses chosen in consultation with a departmental advisor from MATH240, 286, 315, 355, 389, 405, 408, 426, 431, 432, 441, 442, 475, 487, 495; STAT340, CPTR436. Students in a teacher certification program are required to take MATH355, 475, STAT340.

BS: Mathematics Education—30

MATH141, 142, 215, 240, 355, 475; STAT285, 340 and one additional course chosen in consultation with a Mathematics Department advisor from MATH286, 426. This major is available only to those who are obtaining elementary or secondary teacher certification. A major field test in mathematics is required during the senior year.
Cognate Course: CPTR125

Minor in Mathematics Education—20

MATH145, 167, 182, 215, 220, 355, STAT285. This minor is available only to those obtaining elementary teacher certification. The regular minor listed above will also suffice for elementary certification.

Minor in Mathematics of Economics and Finance—20

MATH141, 142, 215, 286, STAT285. 340. This minor is available only to students obtaining a degree in the School of Business.

Behavioral Neuroscience

The Department of Mathematics is a participant in the Behavioral Neuroscience program funded by the National Science Foundation. For more details, see p. 109.

Special Requirements and Placement Test

Sequential Course Numbering. All courses with more than one course number must be taken sequentially.

Non-overlapping Credit Restrictions. Because there is substantial overlap in material covered in the following groups of courses, no student is granted credit (other than general elective credit) in more than one course from each group:
1. MATH141, 182 (Calculus I, Calculus with Applications)
2. MATH145, 166, 168 (Reasoning with Functions, Precalculus Algebra, Precalculus)
Minimum grade for prerequisites, except for MATH141, is C-.

Mathematics Placement Examination (MPE). See p. 36 for information on the MPE and the General Education Mathematics requirement. The MPE score is valid as a prerequisite for mathematics courses for 3 years after it is earned.

Graduate Programs

MS: Mathematics and Science

The Department of Mathematics collaborates with the Departments of Biology, Chemistry, and Physics in this degree. See Mathematics and Science, p. 154.

Endorsement: Middle School Mathematics

The Department of Mathematics collaborates with the School of Education and the Berrien County Intermediate School District to administer the Alternative Certification Experimental Program (Math Endorsement Program) for Middle School Educators. Applications to this Program are initially screened by the School of Education and the Department of Mathematics, and then go through the regular Andrews admissions process. Courses are listed below under "Mathematics Education." Inquiries should be directed to Larry Burton (269) 471-3465, burton@andrews.edu; Lynelle Weldon (269) 471-3866, weldon@andrews.edu; or Judy Wheeler (269) 471-7725 ext. 302, jwheele@remc11.k12.mi.us.

Courses   (Credits)

See inside front cover for symbol code.

Developmental Courses

MATH091 and MATH092 are provided for students not achieving a score of at least P2 on the Mathematics Placement Examination (MPE).

Students complete the sequence MATH091/092 by passing a set of proficiency tests in arithmetic and algebra, at which time a P2 score is awarded. When this occurs, the student has completed the Math Skill part of the General Education requirement, and is considered ready to take MATH 145, 166, 168, or STAT285. Depending on the diligence and previous preparation of the student, this may occur at any time in the MATH091/092 sequence.

MATH091   **(3)**
Arithmetic and Algebra Review I
Individualized review of arithmetic and algebra skills. Provides computer-generated drill problems, instant scoring and explanation, with conceptual instruction as required. Students completing the sequence requirements while enrolled in MATH091 are not required to take MATH092. *Fall, Spring*

MATH092   **(3)**
Arithmetic and Algebra Review II
Continuation of MATH091. Students not completing the sequence requirements but fulfilling attendance, participation, and progress requirements may receive an R grade requiring re-registration the next semester. Prerequisite: Math 091. *Fall, Spring*

Undergraduate Courses

MATH141   **(4)**
Calculus I
MATH141, 142 is a standard introduction to single-variable calculus. MATH141 includes limits, continuity, derivatives, applications, and integration up through substitution. Formal definitions of limit, derivative, and Riemann integral. Proofs

of standard theorems, including the Fundamental Theorem of Calculus. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE=P5 or MATH167 or MATH168 with grade no lower than C. *Fall, Spring*

MATH142   (4)
Calculus II
Continuation of MATH141. Ricmann sums, Riemann integral, Fundamental Theorem of Calculus, techniques of integration, improper integrals, applications, sequences, series, and tests of convergence. Prerequisite: MATH141. *Fall, Spring*

MATH145   (3)
Reasoning with Functions
Logic, sets; functions given by tables, formulas, graphs; inverse functions; linear, quadratic, exponential and trigonometric functions; rates of change and applications to science and business. Additional topics may be selected by the instructor. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE ≥ P2. *Fall, Spring*

MATH165   V (3)
College Algebra
AU/GU course. A study of linear equations and inequalities; algebraic, logarithmic, and exponential functions; polynomials and complex numbers. Includes applications in business and science. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE ≥ P2.

MATH166   (3)
Precalculus Algebra
Equations and inequalities; systems of linear equations; algebraic, polynomial, rational, exponential, and logarithmic functions; inverse functions, complex numbers, applications, and selected topics. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE ≥ P2. *Fall, Spring*

MATH167   Alt (2)
Precalculus Trigonometry
Trigonometric functions and their inverses, identities, trigonometric equations; laws of sines and cosines, vectors, applications, and selected topics. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE ≥ P3 or MATH166 or MATH145. *Fall*

MATH168   (4)
Precalculus
Covers most of the content of MATH166 and MATH167. Equations and inequalities; systems of linear equations; algebraic, polynomial, rational, exponential, and logarithmic functions; inverse functions, complex numbers, trigonometric functions and their inverses, identities, trigonometric equations, laws of sines and cosines, vectors, applications, and selected topics. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE ≥ P2. *Fall, Spring*

MATH168   V (4)
Precalculus
AU/GU course—see content above. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE ≥ P2.

MATH182   Alt (3)
Calculus with Applications
Introduction to single-variable calculus, including limits, differentiation, optimization, and integration with applications to problems in business and the social sciences. Some topics from

multivariable calculus, including partial derivatives and extrema of functions of two variables. Fulfills the General Education Mathematics reasoning requirement. Prerequisite: MPE ≥ P4 or MATH166, 167 or 168 preferred; MATH145 is acceptable. *Spring*

MATH215   (3)
Introduction to Linear Algebra
Vectors, Euclidean *n*-space, matrices, systems of linear equations, determinants, eigenvalues, eigenvectors, vector spaces, and linear transformations with emphasis on applications and computation. Prerequisite: MATH182 or 141. *Fall*

MATH220   Alt (3)
Geometry and Numbers
Euclidean geometry and number systems for elementary and middle school teachers. Topics include proofs, algorithms, and historical development. Prerequisite: MATH145. *Fall*

MATH240   (4)
Calculus III
Standard introduction to multivariable calculus. Vectors and vector functions, curves and surfaces, partial derivatives, multiple integrals, line and surface integrals. Stokes', Green's, and divergence theorems. Prerequisite: MATH142. *Fall*

MATH286   (3)
Differential Equations
Elementary differential equations, first order equations, higher order linear equations, systems. Prerequisite: MATH142. *Spring*

MATH315   Alt (3)
Linear Algebra
Vector spaces, eigenspaces, linear transformations, orthogonality, inner product spaces, quadratic forms, and selected topics. Prerequisites: MATH215, 355. *Spring*

MATH355   (3)
Discrete Mathematics
Selected topics in discrete mathematics, including logic, set theory, relations, functions, algebraic structures and graph theory. Prerequisites: MATH141 or 182. *Spring*

MATH389   (0.5)
Mathematics Colloquium
Participation in at least 10 mathematics colloquia or approved colloquia of other departments. Grade is based on attendance and notes taken at the colloquium. Repeatable to 2 credits. S/U. *Fall, Spring*

MATH405   ♦ Alt (3)
Applied Mathematics
Solutions of first and second order partial differential equations, and applications. Prerequisites: MATH240, 286. *Fall*

MATH408   ♦ Alt (3)
Complex Analysis
Elementary complex analysis, contour integrals, complex series. Prerequisites: MATH240 and 355. *Spring*

MATH426   ♦ Alt (3)
Mathematical Modeling in Biology
Theory and application of linear and nonlinear mathematical models of biological processes. Topics selected from discrete- and continuous-time deterministic and stochastic modeling, analytic solution techniques, linearization, bifurcations, chaos, computer simulation, model parameterization, and model validation. Prerequisite: MATH141. *Fall*

MATH431, 432 ♦ Alt (3, 3)
Advanced Calculus
Theorems on continuity, differentiation, integration, and
convergence; additional selected topics such as topology,
differentiable manifolds, and real analysis. Prerequisites:
MATH240 and 355. *Fall/Spring sequence*

MATH441 ♦ Alt (3)
Algebra
Study of groups, rings, fields, modules, vector spaces, and
algebras. Prerequisites: MATH240 and 355.

MATH442 ♦ Alt (3)
Algebra
Continuation of MATH441. Prerequisite: MATH441.

MATH475 ♦ Alt (3)
Geometry
Axiomatic development and history of Euclidean and non-
Euclidean geometries, constructions, geometric transformations,
and selected topics from finite, fractal, affine, and projective
geometries. Relation of these topics to secondary teaching.
Prerequisite: MATH355. *Fall*

MATH487 Alt (1–3)
Special Topics in _____
Consult the instructor in regard to the topic to be covered.
Prerequisite: Consent of teacher. Repeatable in different areas.

MATH495 (1–3)
Independent Study
Independent study of selected topics in mathematics to enable
advanced students to pursue topics not offered in other scheduled
courses. The student will study under the supervision of a mathe-
matics professor whose prior approval is required. Ordinarily a
minimum of four hours of study per week is expected for each
credit. Grades are assigned on the basis of a instructor-selected
procedure such as oral or written exams or reports.

Statistics

STAT285 (3)
Elementary Statistics
A study of basic descriptive and inferential statistics, including
elementary probability and probability distributions, statistical
inference involving binomial, normal, and *t*-distributions, and
hypothesis testing. Prerequisite: MPE ≥ P2. *Fall, Spring*

STAT285 V (4)
Elementary Statistics
AU/GU course—see content above. Prerequisite: MPE ≥ P2.

STAT340 (3)
Probability Theory with Statistical Applications
Probability theory and statistics for students having preparation
in calculus. Topics include probability models, combinatoric
problems, random variables, discrete and continuous distributions,
expectation, moment generating functions, central limit theorem.
Prerequisite: MATH141 or 182. *Spring*

Honors

MATH271-50 (1)
Honors in Mathematics
The study of mathematical problems where the solution depends more

on insight and creativity than on routine computation. Repeatable to 2
credits. Prerequisite: MATH142 and consent of instructor.

Graduate Courses

MATH530 (2-3)
Topics in Teaching Mathematics
   A. Algebra
   B. Geometry
   C. Analysis
   D. Applications
Consult with department chair regarding availability in any given
year. Repeatable to 6 credits.

MATH540 Alt (2-3)
Topics in Mathematics
Consult with the instructor in regard to the topic to be covered.
Prerequisite: Consent of the instructor. Repeatable to 6 credits.

Mathematics Education Courses
The Department of Mathematics collaborates with the School of
Education and the Berrien County Intermediate School District to
offer these courses when funding is available. The type of funding
may place restrictions on enrollment in these courses. Inquiries
should be directed to one of the following individuals:
Larry Burton (269) 471-3465, burton@andrews.edu
Lynelle Weldon (269) 471-3866, weldon@andrews.edu
Judy Wheeler (269) 471-7725, ext.302, jwheele@remc11.k12.mi.us

MAED505 (2–3)
*Understanding Numbers and Operations for Middle Grades
Educators*
This course is designed to strengthen middle school teachers'
rational number knowledge and number sense. This includes
the in-depth study of rational numbers and operations on rational
numbers, the structure of the rational and real number systems,
algorithms for computation, estimation strategies, and working with
very large and very small numbers. The pedagogy of the course
models that of effective middle school mathematics teachers.

MAED510 (3)
Exploring Algebra and Functions for Middle Grades Educators
This course extends the middle school teachers' understanding
of algebra as a symbolic language. This course moves beyond
symbol manipulation to include modeling of physical situations.
Students will explore algebraic, linear, and non-linear functions
within the context of the course. The pedagogy of the course
models that of effective middle school mathematics teachers.

MAED515 (3)
Data Analysis for Middle Grades Educators
This course presents an integrated approach to data analysis,
statistics, and probability for middle grades math teachers.
Instruction focuses on specific real-world data sets and statistical
investigations. The pedagogy of the course models that of
effective middle school mathematics teachers.

MAED521 (2)
*Informal Geometry and Measurement for Middle Grades
Educators*
This course is the first of two which lead prospective mathematics
teachers through a series of explorations to develop competence
in geometric reasoning, including conjecture, proving, and
disproving. Prospective teachers develop a deeper understanding

of the role of proof in geometry. The pedagogy of this course models that of effective middle school mathematics teachers.

MAED522   **(2)**
Formal Geometry for Middle Grades Educators
This course is the second of two which lead prospective mathematics teachers through a series of explorations to develop competence in geometric reasoning, including conjecturing, proving, and disproving. Prospective teachers refine their understanding of the role of proof in geometry. The pedagogy of the course models that of effective middle school mathematics teachers.

MAED600   **(2)**
Discrete Mathematics and Number Theory for Middle Grades Educators
Students investigate concepts of number theory, discrete mathematics, and logic as they apply to middle grades mathematical education. Each topic includes a study of graphic representation of concepts and applications in technology. The pedagogy of the course models that of effective middle school mathematics teachers.

MAED610   **(4)**
Mathematical Modeling for Middle Grades Educators
Investigation of concepts and practices of mathematical modeling with an emphasis on application to middle grades education. The pedagogy of the course models that of effective middle school mathematics teachers.

MAED625   **(2)**
Mathematical Investigations for Middle Grades Classrooms
Participants investigate topics in mathematics, including probability, programming, fractals, and chaos theory. Emphasis is placed on participant understanding of these topics and their appropriate use as investigations with middle grades students. The pedagogy of the course models that of effective middle school mathematics teachers.

MAED 630   **(1-4)**
Seminar:_____
Seminar in specific topics relevant to mathematics education. Each seminar examines one topic in detail. Repeatable with different topics. May be graded S/U.

MATHEMATICS AND SCIENCE

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Shandelle M. Henson, Mathematics
Joon Hyuk Kang, Mathematics
Mickey D. Kutzner, Physics
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David N. Mbungu, Biology
Getahun Merga, Chemistry
Robert C. Moore, Mathematics
Desmond H. Murray, Chemistry
Marlene N. Murray, Biology
G. William Mutch, Chemistry
D. David Nowack, Chemistry
Yun Myung Oh, Mathematics
S. Clark Rowland, Physics
David A. Steen, Biology
John F. Stout, Biology
Tiffany Z. Summerscales, Physics
Stephen C. Thorman, Physics, Computer Science
Lynelle M. Weldon, Mathematics
Dennis W. Woodland, Biology
Peter A. Wong, Chemistry
Robert E. Zdor, Biology

MS: Mathematics and Science
The Master of Science: Mathematics and Science is designed for students who wish to acquire a breadth of knowledge which cannot be achieved within any one discipline among mathematics, biology, chemistry and physics. Such a degree may be useful for secondary or middle-school teachers who teach mathematics and science subjects, but who do not desire a traditional MAT program; for those who wish to develop skills in areas of overlap in these disciplines; for those who wish to study the interrelationships among the disciplines; and for those who wish further preparation for careers in industry or government.

In addition to the general requirements for admission to and enrollment in graduate degree programs outlined in this bulletin, students must meet departmental requirements.

Admission Requirements
• A bachelor's degree with a major in Mathematics, Biology, Chemistry, or Physics, and a minimum GPA of 3.00 (B) in mathematics and science courses.
• Completed the GRE General Exam for admission to regular student status. Completion of the GRE Subject Exam in one of the four areas of Mathematics, Biology, Chemistry or Physics is recommended.
• Earned credit or demonstrated proficiency in the following prerequisites: CPTR125 (FORTRAN or C++) or CPTR151; MATH141, 142, 240, 286; and two out of three year-long