

MATHEMATICS

College of Science, Health & Engineering

Barbara Alvin, PhD, Chair		216 Kingston Hall	509.359.2203
BA	BAE	Minors	MS

Faculty:

K. Adolphson, B. Alvin, L. Blair, L. Bolte, D. Canada, J. Coomes, D. Dowd, D. Garraway, R. Gentle, D. Goering, M. Graham, M. Graham, C. Hansen, J. Lane, H. S. Lee, K. Lynn, Y. Nievergelt, H. Sullivan, E. Toneva

UNDERGRADUATE PROGRAMS

Mathematics is both an art and a science: it has the unique feature that, while it is typically studied for its own sake, throughout history its results have been crucial in the advancement of other sciences. Presently there is a shortage of American mathematicians. Many professionals at the forefront of the behavioral, social and pure sciences also must have a solid background in advanced mathematics.

Among the degrees offered by the department are Bachelor of Arts degrees in Mathematics or Mathematics with an Option in Computer Science, Economics or Statistics which are designed to prepare students for graduate work in mathematics or in related disciplines such as statistics or economics or to equip students for work in industry. Well-prepared entering freshmen may opt to combine the Bachelor of Arts in Mathematics program with the Master of Science in Mathematics in the Five-Year Bachelor of Arts/Master of Science in Mathematics program.

The program leading to the BA in mathematics is especially strong and is unique within the region. The department strives to promote excellence; it fields teams for the Putnam competition and prepares students for actuarial exams. It also sponsors a chapter of the mathematical honorary society, Pi Mu Epsilon. Recent graduates are successfully pursuing doctoral work at top-level universities.

The purpose of the five-year program is to provide mathematically talented high school students in the state of Washington the opportunity to earn a bachelor's degree and a master's degree in mathematics in five years. This program is highly competitive and prepares students for careers in industry, for careers in community college teaching and for further graduate studies.

The other degrees offered by the department are the Bachelor of Arts in Education in Secondary and in Elementary Mathematics Education. The preparation of mathematics teachers is a major emphasis of the department. Seven department faculty members have expertise in mathematics education and experience teaching elementary, middle and/or high school mathematics. Employment opportunities for teaching mathematics at elementary, middle and secondary levels are substantial and expected to remain high for the foreseeable future.

The department's mathematics education programs prepare future teachers by providing background in mathematics content, history of mathematics, teaching methods, learning theories, problem solving, the use of technology in teaching mathematics and current developments in curriculum. The secondary mathematics education program is one of the strongest in the state and provides students with a mathematics background that approaches that of the BA in mathematics. Completion of a major or minor in secondary mathematics education satisfies the current requirements for a secondary mathematics teaching endorsement (certificate) for the state of Washington. The elementary mathematics education program is unique in the state; it provides a balance of mathematics content and teaching methods courses to give prospective K-8 teachers a deeper background in mathematics and the teaching of K-8 mathematics. Graduates of this program have the background to be mathematics content specialists at the elementary school level. The middle level endorsement secondary or elementary program options meet the state requirements for mathematics certification at the 4th through 9th grade levels.

The department has been strengthening its faculty and its faculty members are increasingly active in research. On occasion, undergraduates have been involved in research. Currently, faculty members are active in the areas of statistics, higher algebra, real and harmonic analysis, numerical analysis, complex variables, differential geometry, convexity and topology and in various areas of mathematics education including concept maps, functions, number sense in primary children and construction of mathematical understanding.

An important function of the department is to provide services to students from a wide range of disciplines. Mathematics tutoring labs provide employment for high-achieving students and assistance to students in all mathematics courses.

In addition, computers equipped with mathematics software and tutorials are used in conjunction with several courses offered by the department and allow students the practice needed to be successful in their mathematics courses.

General Admissions Requirements for Mathematics

High school students who want to pursue a major in this department (except the BAE elementary mathematics) should complete four years of high school mathematics, which includes two years of algebra, one year of geometry and one year of pre-calculus mathematics. All prospective department majors should contact the Department of Mathematics office as soon as possible after being admitted to EWU to obtain an advisor and to plan a program of study.

Transfer students should contact their counseling office or the EWU Department of Mathematics to identify appropriate lower-division and major/minor preparatory courses.

Placement Testing Policy

All students admitted to Eastern Washington University without a direct transfer degree must take the mathematics placement test (APTP) prior to registering for classes at Eastern. The only exceptions are students who have received a score of 3.0 or higher on the advanced placement calculus AB or BC test and students who have received a grade of 2.0 or higher from a post-secondary institution in a course equivalent to the level of *Intermediate Algebra* or above.

There are two test types: The intermediate mathematics placement test and the advanced mathematics placement test. The intermediate MPT has 35 questions from the topics of *Elementary Algebra, Intermediate Algebra and Precalculus I* (topics from Algebra I and II in high school). The advanced MPT has 30 questions from the topics of *Intermediate Algebra, Precalculus and Calculus*. The test you take depends on your background in mathematics and placement in a mathematics course is determined by the percentage of problems answered correctly.

A photo ID card and fee payment receipt are required at testing time. No calculators are allowed. The same mathematics placement test type may be taken twice in any 12-month period, with at least two weeks between test dates. For more information contact the Department of Mathematics.

Prerequisite Policy

Students must have earned a grade of 2.0 or better in any course that is to be used to satisfy a prerequisite requirement for a subsequent mathematics course offered by the Eastern Washington University Department of Mathematics.

Academic Progress Policy for Math Majors and Minors

The intent of the Academic Progress Policy is to support Department of Mathematics declared majors and minors who experience difficulty in mathematics courses required in their programs. Department experience has shown that with very few exceptions, requiring a student who has failed to earn a 2.0 in a required mathematics course to meet with an advisor will be beneficial to the student in terms of maximizing the student's academic performance and minimizing the expected time to graduation. A mathematics student is any Eastern Washington University student who intends to complete a major or minor in mathematics; mathematics with an option in computer science, economics, or statistics; mathematics/secondary; or mathematics/elementary.

Mathematics students who fail to make at least a 2.0 grade in any mathematics course taken at EWU must review the circumstances with an academic advisor during the term following the failure. A letter from the student explaining the circumstances must be placed in the student's file. Mathematics students failing to follow this procedure will not be allowed to enroll in subsequent mathematics courses.

Mathematics students who fail to make at least a 2.0 grade in mathematics courses taken at EWU on any two quarters during their undergraduate

program must meet during the term following the second occurrence with a committee consisting of the student's appointed advisor and two other members of the mathematics faculty: one designated by the department chair and one chosen by the student. The committee will review the circumstances including the letter submitted after the first occurrence and recommend one of the following actions:

- a. the student be allowed to continue in the program without specific remediation;
- b. the student be required to remediate specific deficiencies in a way prescribed by the committee.

Mathematics students who fail to make at least a 2.0 grade in mathematics courses in three quarters during their undergraduate program must again meet with a committee of at least three faculty members who will decide if the student will be allowed to continue in the program. Students who are dropped from mathematics programs may be reinstated only by demonstrating the capability of academic excellence and a commitment to complete an undergraduate program in a reasonable time frame. This demonstration must be made before a committee of at least three members of the mathematics faculty.

Mathematics students who are dropped from mathematics programs will not be allowed to take subsequent mathematics courses except for those courses required by another department in the student's major program. The Department of Mathematics will not submit a letter of recommendation for Professional Degree Candidacy for any student who has been dropped from departmental programs.

Graduation Requirement

Students must receive a grade of 2.0 or better in each mathematics course used to satisfy the requirements of an undergraduate major or minor in mathematics.

Five-Year Bachelor of Arts/Master of Science in Mathematics Program

Students seeking entrance into the five-year Bachelor of Arts/Master of Science in mathematics program are required to:

1. take a year of Calculus in their senior year at a college or at their high school. If the student takes Calculus at a college, he or she must average 3.5 or better. If the student takes Calculus in high school, he or she must take the Calculus Advanced Placement Exam (preferably the BC) and earn a 4 or a 5;
2. apply to the Department of Mathematics for admission into the program; a letter of recommendation from a high school mathematics teacher is required.

Required courses in the following programs of study may have prerequisites. Reference the course description section for clarification.

BACHELOR OF ARTS (BA)

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- apply knowledge gained in computer science courses to mathematical problems;
- apply mathematical concepts to economics;
- write clear, well-reasoned proofs;
- understand the interconnectedness between mathematics and economics;
- understand the interconnectedness between various branches of mathematics;
- demonstrate competence in mathematics and school mathematics.

MATHEMATICS MAJOR (89 CREDITS)

Note: two years of a single high school foreign language or one year of a single college level foreign language is required.

Required Courses (52 credits)

- MATH 161 Calculus I (5)
- MATH 162 Calculus II (5)
- MATH 163 Calculus III (5)
- MATH 225 Foundations of Mathematics (5)
- MATH 231 Linear Algebra (5)
- MATH 241 Calculus IV (5)
- MATH 360 or 460 Continuous Functions (4)
- MATH 431 Introduction to Modern Algebra I (4)
- MATH 432 Introduction to Modern Algebra II (4)
- MATH 461 Advanced Calculus I (4)
- MATH 462 Advanced Calculus II (4)
- MATH 494 Senior Seminar (2) (2.0 must be obtained for graduation)

Mathematics Electives—Select six courses from the following (24 credits)

- MATH 345 Numerical Analysis I (4)
- MATH 347 Introductory Differential Equations (4)*
- MATH 385 Probability and An Introduction to Statistics (4)
- MATH 430 Advanced Linear Algebra (4)*
- MATH 433 Introduction to Modern Algebra III (4)*

- MATH 445 Numerical Analysis II (4)*
- MATH 447 Differential Equations (4)*
- MATH 470 Foundations of Geometry (4)*
- MATH 481 Complex Analysis (4)*
- MATH 485 Theoretical Probability and Mathematical Statistics (4)*

Supporting Courses (13 credits)

Courses satisfying this requirement must be selected from the following two lists, with at least 5 credits from List A and at least 8 credits from List B. Additional prerequisites may be required for List A courses. Please check computer science course descriptions for prerequisite listings.

List A

- CSCD 210 Programming Principles I (5)
- CSCD 211 Programming Principles II (5)
- CSCD 255 C Programming for Engineers (5)
- CSCD 305 C++ Programming (4)

List B

- CHEM 421 Physical Chemistry (4)
- CHEM 422 Physical Chemistry (3)
- CHEM 423 Physical Chemistry (3)
- CSCD 420 Automata (4)
- CSCD 501 Design and Analysis of Algorithms (4)
- ECON 430 Mathematical Economics (5)
- PHYS 151 General Physics I (4)
- PHYS 152 General Physics II (4)
- PHYS 153 General Physics III (4)

Required program credits	52 credits
Mathematics elective credits	24 credits
Required supporting credits	13 credits
Total credits for above major	89 credits

MATHEMATICS MAJOR WITH COMPUTER SCIENCE OPTION (103 CREDITS)

Note: two years of a single high school foreign language or one year of a single college level foreign language is required.

Required Courses (44 credits)

- MATH 161 Calculus I (5)
- MATH 162 Calculus II (5)
- MATH 163 Calculus III (5)
- MATH 225 Foundations of Mathematics (5)
- MATH 231 Linear Algebra (5)
- MATH 241 Calculus IV (5)
- MATH 345 Numerical Analysis I (4)
- MATH 360 Continuous Functions
or MATH 460 Continuous Functions (4)
- MATH 385 Probability and An Introduction to Statistics (4)
- MATH 494 Senior Seminar (2) (2.0 must be obtained for graduation)

Required Supporting Courses: Computer Science (31 credits)

- CSCD 110 Introduction to Programming (5)
- CSCD 210 Programming Principles I (5)
- CSCD 211 Programming Principles II (5)
- CSCD 240 C and UNIX Programming (4)
- CSCD 300 Data Structures (4)
- CSCD 320 Algorithms (4)
- CSCD 327 Relational Database Systems (4)

Electives: (28 credits)

Select three courses from one of the following two categories and four courses from the remaining category (for a total of seven courses):

Category 1

- MATH 347 Introductory Differential Equations (4)*
 - MATH 431 Introduction to Modern Algebra I (4)*
 - MATH 445 Numerical Analysis II (4)
 - MATH 447 Differential Equations (4)*
 - MATH 485 Theoretical Probability and Mathematical Statistics (4)*
- Any other 4 credit mathematics course numbered at or above 400 with the approval of the designated advisor for this degree.

Category 2

- CSCD 260 Architecture and Organization (4)
- CSCD 303 Computer & Information Security (4)
- CSCD 305 C++ Programming (4)
- CSCD 306 .NET Programming (4)
- CSCD 340 Operating Systems
- CSCD 370 Graphical User Interface Programming (4)
- CSCD 378 Web Application Development (4)
- CSCD 409 Scientific Programming (4)
- CSCD 420 Automata (4)
- CSCD 427 Advanced Database Systems (4)
- CSCD 429 Data Mining (4)
- CSCD 435 Principles of Programming Languages (4)
- CSCD 437 Secure Coding (4)
- CSCD 470 3D Computer Graphics Principles (4)

CSCD 474 Computer Games Development (4)
 CSCD 487 Human Computer Interface (4)
 Any other 4 credit computer science course numbered at or above 400 with the approval of the designated advisor for this degree.

Required mathematics credits:	44 credits
Required computer science credits:	31 credits
Required elective credits:	28 credits
Minimum total required credits for above major:	103 credits

MATHEMATICS MAJOR WITH ECONOMICS OPTION (83 CREDITS)

Note: two years of a single high school foreign language or one year of a single college level foreign language is required.

Required Courses

CSCD 110 Introduction to Programming (5)
 or CPLA 120 Computer Applications Literacy (5)
 ECON 200 Introduction to Microeconomics (5)
 ECON 201 Introduction to Macroeconomics (5)
 ECON 404 Intermediate Microeconomic Theory (5)
 ECON 405 Intermediate Macroeconomic Theory (5)
 ECON 430 Mathematical Economics (5)
 ECON 437 Econometrics (5)
 MATH 161 Calculus I (5)
 MATH 162 Calculus II (5)
 MATH 163 Calculus III (5)
 MATH 225 Foundations of Mathematics (5)
 MATH 231 Linear Algebra (5)
 MATH 241 Calculus IV (5)
 MATH 345 Numerical Analysis I (4)
 MATH 347 Introductory Differential Equations (4)*
 MATH 385 Probability and an Introduction to Statistics (4)
 MATH 445 Numerical Analysis II (4)*
 or MATH 485 Theoretical Probability and Mathematical Statistics (4)*
 MATH 494 Senior Seminar (2) (2.0 must be obtained for graduation)

Minimum total credits for above major **83 credits**

Note: Because the above is an interdisciplinary program, it is necessary to consult with an advisor to determine if the courses above may be used to fulfill a **GEGR**. Students considering graduate study in mathematical economics are advised to take MATH 360 or 460 and 461.

MATHEMATICS MAJOR WITH STATISTICS OPTION (87 CREDITS)

Note: two years of a single high school foreign language or one year of a single college level foreign language is required.

Required Courses (79 credits)

MATH 161 Calculus I (5)
 MATH 162 Calculus II (5)
 MATH 163 Calculus III (5)
 MATH 225 Foundations of Mathematics (5)
 MATH 231 Linear Algebra (5)
 MATH 241 Calculus IV (5)
 MATH 345 Numerical Analysis I (4)
 MATH 360 or 460 Continuous Functions (4)
 MATH 385 Probability and An Introduction to Statistics (4)
 MATH 386 Applied Statistics (4)
 MATH 461 Advanced Calculus I (4)
 MATH 462 Advanced Calculus II (4)
 MATH 485 Theoretical Probability and Mathematical Statistics (4)*
 MATH 486 Advanced Topics in Statistics (3)*
 MATH 494 Senior Seminar (2) (2.0 must be obtained for graduation)

Select four courses from the following

MATH 431 Introduction to Modern Algebra I (4)
 MATH 432 Introduction to Modern Algebra II (4)
 MATH 433 Introduction to Modern Algebra III (4)*
 MATH 445 Numerical Analysis II (4)*
 MATH 447 Differential Equations (4)*
 MATH 470 Foundations of Geometry (4)*
 MATH 481 Complex Analysis (4)*

Electives (8 credits)

Courses satisfying this requirement must come from outside the Department of Mathematics and are to be selected in consultation with the department advisor.

Required program credits	79 credits
Elective credits	8 credits
Total credits for above major	87 credits

Note: If this is your chosen program, you should meet with a department advisor to plan your schedule before taking classes. See the EWU catalog for details and see a department advisor at least twice a year to review your program. Make an appointment with Barbara Alvin by calling 509.359.2203.

FIVE-YEAR BACHELOR OF ARTS (BA)/MASTER OF SCIENCE (MS) IN MATHEMATICS (129 CREDITS)

Note: two years of a single high school foreign language or one year of a single college level foreign language is required.

Required Courses (52 credits undergraduate and 44 credits graduate)

MATH 161 Calculus I (5)
 MATH 162 Calculus II (5)
 MATH 163 Calculus III (5)
 MATH 225 Foundations of Mathematics (5)
 MATH 231 Linear Algebra (5)
 MATH 241 Calculus IV (5)
 MATH 360 or 460 Continuous Functions (4)
 MATH 431 Introduction to Modern Algebra I (4)
 MATH 432 Introduction to Modern Algebra II (4)
 MATH 461 Advanced Calculus I (4)
 MATH 462 Advanced Calculus II (4)
 MATH 494 Senior Seminar (2) (2.0 must be obtained for graduation)
 MATH 531 Algebra I (4)
 MATH 532 Algebra II (4)
 MATH 533 Algebra III (4)
 MATH 551 General Topology I (4)
 MATH 561 Real Analysis I (4)*
 MATH 562 Real Analysis II (4)*
 MATH 573 Topics in Applied Mathematics (4)
 MATH 581 Complex Analysis I (4)*
 MATH 582 Complex Analysis II (4)*
 MATH 600 Thesis (8)

Mathematics Electives—select five courses from the following (20 credits)

MATH 345 Numerical Analysis I (4)
 MATH 347 Introductory Differential Equations (4)*
 MATH 385 Probability and An Introduction to Statistics (4)
 MATH 430 Advanced Linear Algebra (4)*
 MATH 433 Introduction to Modern Algebra III (4)*
 MATH 445 Numerical Analysis II (4)*
 MATH 447 Differential Equations (4)*
 MATH 470 Foundations of Geometry (4)*
 MATH 481 Complex Analysis (4)*
 MATH 485 Theoretical Probability and Mathematical Statistics (4)*

(For students wishing to pursue careers in industry, the Department of Mathematics recommends the following five courses: MATH 345, MATH 385, MATH 445, MATH 470 and MATH 485; for students wishing to pursue a PhD in Mathematics, we recommend MATH 385, MATH 430, MATH 452, MATH 470 and any other from the list.)

Supporting Courses (13 credits)

Courses satisfying this requirement must be selected from the following two lists, with at least 5 credits from List A and at least 8 credits from List B. Additional prerequisites may be required for List A courses. Please check computer science course descriptions for prerequisite listings.

List A

CSCD 210 Programming Principles I (5)
 CSCD 211 Programming Principles II (5)
 CSCD 255 C Programming for Engineers (5)
 CSCD 305 C++ Programming (4)

List B

CHEM 421 Physical Chemistry (4)
 CHEM 422 Physical Chemistry (3)
 CHEM 423 Physical Chemistry (3)
 CSCD 420 Automata (4)
 CSCD 501 Design and Analysis of Algorithms (4)
 ECON 430 Mathematical Economics (5)
 PHYS 151 General Physics I (4)
 PHYS 152 General Physics II (4)
 PHYS 153 General Physics III (4)

Master's Thesis

A Master's thesis in mathematics should make an original and constructive contribution to its field, at least in exposition if not in new mathematics. To this end, a thesis should demonstrate:

- a. a mastery of a substantial body of mathematics;
- b. the ability to search the mathematics literature; and
- c. a talent for presenting mathematics clearly in correct English.

Ideally, a Master's thesis may establish a new result, but new results are not required. Instead, a thesis may present mathematics from other research works, in an exposition accessible to mathematicians who do not specialize in the topic of the thesis. The final version of the thesis may follow either a local format or a format required for submission to a professional mathematics journal.

Final Comprehensive Examination

A two-hour final examination conducted by the chair of the candidate's graduate committee is required. The candidate will present his or her thesis for the first hour. The remaining time is to be left for questions from the committee on the thesis as well as material selected from the candidate's coursework.

Note: After having completed 180 credits and met all university graduation requirements for a BA, the students in this program will have the option not to take the fifth year and instead graduate with a BA in Mathematics provided one of the following conditions is met: a. The student has met all departmental requirements for a BA in Mathematics. b. The student has met alternative requirements approved by the department chair. Students apply for admission to the graduate program in the spring quarter of the fourth year and must meet the entrance requirements of the graduate school. Upon acceptance to the graduate school (ordinarily when the student reaches 180 credits), the student officially becomes a graduate student, will pay graduate tuition and may apply for a graduate instructorship.

Note: Students in the BA/MS Mathematics program are required to complete a minimum of 45 credits toward the graduate degree that are included on an application for graduate degree candidacy and approved by the Mathematics graduate advisor and the Graduate Studies Office. These credits may come from courses numbered 400 or above, as long as at least half are from courses numbered 500 or above. Graduate-level credits (from courses numbered 500 and above) may count toward either the BA or MS degree requirements, but no single course may count toward both degrees.

Required undergraduate credits	52 credits
Required graduate credits	44 credits
Mathematics elective credits	20 credits
Required supporting credits	13 credits
Total credits for above major	129 credits

BACHELOR OF ARTS IN EDUCATION (BAE)

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- understand and apply the mathematical processes of problem solving, reasoning, communicating and connecting, use varied representations to support and deepen mathematical understanding, and embrace technology as an essential tool for teaching and learning mathematics;
- demonstrate computational proficiency using various strategies, including a conceptual understanding of numbers, relationships among number and number systems and meanings of operations with all real numbers;
- understand relationships among quantities, functions, and the analysis of change, and demonstrate a conceptual understanding of and procedural facility with fundamental single variable calculus;
- use spatial visualization and geometric modeling to explore and analyze geometric figures and apply and use measurement concepts and tools;
- demonstrate an understanding of concepts and practices related to data analysis, statistics and probability, and apply the fundamental ideas of discrete mathematics in the formulation and solution of problems;
- possess a deep understanding of how students learn mathematics and of the pedagogical knowledge specific to mathematics teaching and learning.

MATHEMATICS/ELEMENTARY MAJOR (48 CREDITS)

Completion of this major, the General Degree Completion Requirements for Education, Elementary and a minor field of study satisfies the state requirements for an Elementary Education teaching endorsement.

Required Courses

MATH 114 Algebra Concepts (5)
 MATH 211 Structure of Elementary Mathematics I (5)*
 MATH 212 Structure of Elementary Mathematics II (5)*
 MATH 311 Functions and Relations for K–8 Teachers (5)
 MATH 312 Geometry for the K–8 Teacher (5)
 MATH 411 Discrete Mathematics for K–8 Teachers (4)
 MATH 420 Problem Solving for K–8 Teachers (4)
 MTED 390 Methods of Teaching Elementary School Mathematics (5)*
 MTED 412 Advanced Methods of Teaching K–8 Mathematics (5)
 MTED 490 Senior Capstone: Mathematics Practicum (5)

Total credits for above major	48 credits
Professional education requirements/elementary education:	73–74 credits*
<i>See the Department of Education section of this catalog. Prerequisites may also apply.</i>	

Minimum total credits for above major and professional education **121 credits**
 *MATH 211, 212, and MTED 390 are required courses in the Professional Education Requirements/Elementary. The actual total of credits for this major and professional education is 106 credits.

Note: the above major requires the completion of a minor.

MATHEMATICS/ELEMENTARY MAJOR AND MIDDLE LEVEL ENDORSEMENT OPTION (58 CREDITS)

Completion of this major, the General Degree Completion Requirements for Education, Elementary, and a minor field study satisfies the state requirements for an Elementary Education teaching endorsement and a Middle Level Mathematics teaching endorsement (grade levels 4–9).

Required Courses

EDUC 417 Culture of Middle Level School (3)
 MATH 114 Algebra Concepts (5)
 MATH 211 Structure of Elementary Mathematics I (5)*
 MATH 212 Structure of Elementary Mathematics II (5)*
 MATH 311 Functions and Relations for K–8 Teachers (5)
 MATH 312 Geometry for the K–8 Teacher (5)
 MATH 411 Discrete Mathematics for K–8 Teachers (4)
 MATH 413 Data Analysis and Probability for Middle Level Teachers (3)
 MATH 416 Calculus for Middle Level Teachers (4)
 MATH 420 Problem Solving for K–8 Teachers (4)
 MTED 390 Methods of Teaching Elementary School Mathematics (5)*
 MTED 412 Advanced Methods of Teaching K–8 Mathematics (5)
 MTED 490 Senior Capstone: Mathematics Practicum (5)

Total credits for above major	58 credits
Professional education requirements/elementary education:	73–74 credits*
<i>See the Department of Education section of this catalog. Prerequisites may also apply.</i>	

Minimum total credits for above major and professional education **116 credits***
 *MATH 211, 212, and MTED 390 are required courses in the Professional Education Requirements/Elementary.

Note: effective 09-01-05 all candidates for certification must pass the WEST-E Praxis II subject matter test to receive an endorsement for certification purposes.

Note: the above major requires the completion of a minor other than mathematics.

MATHEMATICS/SECONDARY MAJOR (77 CREDITS)

Completion of this major and the General Degree Completion Requirements for Education, Secondary, satisfies the state requirements for a state mathematics teaching endorsement (secondary, grade levels 5–12).

Required Courses

MATH 161 Calculus I (5)
 MATH 162 Calculus II (5)
 MATH 163 Calculus III (5)
 MATH 225 Foundations of Mathematics (5)
 MATH 231 Linear Algebra (5)
 MATH 241 Calculus IV (5)
 MATH 320 History of Mathematics (4)
 MATH 360 Continuous Functions (4)
 MATH 370 Survey of Geometries (5)
 MATH 385 Probability and An Introduction to Statistics (4)
 MATH 386 Applied Statistics (4)
 MATH 431 Introduction to Modern Algebra I (4)
 MATH 432 Introduction to Modern Algebra II (4)
 MATH 492 Problem Solving Seminar (5)
 MATH 494 Senior Seminar (2) (2.0 must be obtained for graduation)
 MTED 393 Methods of Teaching Secondary Mathematics I (3)
 MTED 490 Senior Capstone: Mathematics Practicum (5)
 MTED 493 Methods of Teaching Secondary Mathematics II (3)

Total credits for above major	77 credits
Professional education requirements/secondary education:	46–47 credits
<i>See the Department of Education section of this catalog. Prerequisites may also apply.</i>	

Minimum total credits for above major and professional education **123 credits**
Note: the above major takes more than 12 quarters at 15–16 credits a quarter.

MINORS

MATHEMATICS MINOR (29–30 CREDITS)

Required Courses (25 credits)

MATH 161 Calculus I (5)
 MATH 162 Calculus II (5)
 MATH 163 Calculus III (5)
 MATH 225 Foundations of Mathematics (5)
 MATH 231 Linear Algebra (5)

Select one course from the following (4–5 credits)

MATH 345 Numerical Analysis I (4)
 MATH 360 or 460 Continuous Functions (4)
 MATH 370 Survey of Geometries (5)
 MATH 385 Probability and An Introduction to Statistics (4)

Required program credits	25 credits
Required select one credits	4–5 credits
Minimum total credits for above minor	29 credits

MATHEMATICS/ELEMENTARY MINOR (34 CREDITS)

Completion of this minor, the General Degree Completion Requirements for Education, Elementary and a major field of study, satisfies the state requirements for an Elementary Education teaching endorsement.

Required Courses

- MATH 114 Algebra Concepts (5)
- MATH 211 Structure of Elementary Mathematics I (5)*
- MATH 212 Structure of Elementary Mathematics II (5)*
- MATH 311 Functions and Relations for K-8 Teachers (5)
- MATH 420 Problem Solving for K-8 Teachers (4)
- MTED 390 Methods of Teaching Elementary School Mathematics (5)*
- MTED 412 Advanced Methods of Teaching K-8 Mathematics (5)

Total credits for above minor

34 credits

Note: *MATH 211, 212, and MTED 390 are required courses in the Professional Education Requirements/Elementary. The actual total of additional credits for this minor when elementary education professional requirements are completed is 19 credits.

MATHEMATICS/SECONDARY

MIDDLE LEVEL ENDORSEMENT/MINOR* (58 CREDITS)

Completion of this minor, the General Degree Completion Requirements for Education, Secondary, and a major field of study satisfies the state requirements for a middle level mathematics teaching endorsement (grade levels 4-9).

Required Courses

- EDUC 417 The Culture of Middle Level School (3)
- MATH 114 Algebra Concepts (5)
- MATH 211 Structure of Elementary Mathematics I (5)**
- MATH 212 Structure of Elementary Mathematics II (5)**
- MATH 311 Functions and Relations for K-8 Teachers (5)
- MATH 312 Geometry for the K-8 Teacher (5)
- MATH 411 Discrete Mathematics for K-8 Teachers (4)
- MATH 413 Data Analysis and Probability for Middle Level Teachers (3)
- MATH 416 Calculus for Middle Level Teachers (4)
- MATH 420 Problem Solving for K-8 Teachers (4)
- MTED 390 Methods of Teaching Elementary School Mathematics (5)*
- MTED 412 Advanced Methods of Teaching K-8 Mathematics (5)
- MTED 490 Senior Capstone: Mathematics Practicum (5)

Total credits for above minor

58 credit

*This minor can be completed for an add-on Middle Level Mathematics Endorsement.
**The completion of MATH 211 and 212 satisfies the university Mathematical Reasoning competency/proficiency requirement and the MATH 115 requirement in the secondary education program.

Note: effective 09-01-05, all candidates for certification must pass the WEST-E Praxis II subject matter test to receive an endorsement for certification purposes.

MATHEMATICS/SECONDARY MINOR (39 CREDITS)

Completion of this minor, the General Degree Completion Requirements for Education, Secondary and a major field of study satisfies the state requirements for a state mathematics teaching endorsement (secondary, grade levels 5-12).

Required Courses

- MATH 161 Calculus I (5)
- MATH 225 Foundations of Mathematics (5)
- MATH 231 Linear Algebra (5)
- MATH 320 History of Mathematics (4)
- MATH 370 Survey of Geometries (5)
- MATH 380 Elementary Probability and Statistics (5)
- MATH 431 Introduction to Modern Algebra I (4)
- MATH 492 Problem Solving Seminar (5)
- MTED 393 Methods of Teaching Secondary Mathematics I (3)
- MTED 493 Methods of Teaching Secondary Mathematics II (3)

Total credits for above minor

44 credits

Note: Certain mathematics courses will be offered every other year, alternating according to the following schedule: even numbered years: 342,430,445,481,486,,581,582. Odd numbered years: 433,447,470,485,561,562. (2010-2011 is an even year; 2009-2010 is an odd year) Students need to take this into account when planning a program of study in the Department of Mathematics.

GRADUATE PROGRAMS

MASTER OF ARTS IN TEACHING K-9 MATHEMATICS

Keith Adolphson, Program Advisor	209 Kingston Hall	509.359.6066
----------------------------------	-------------------	--------------

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- Develop a deep and connected understanding of mathematics concepts;
- Develop a deep and connected understanding of pedagogical content knowledge;
- Understand the research base for teaching mathematics;
- Incorporate research findings to solve practical issues of teaching K-9 mathematics;
- Understand the role of and demonstrate effective assessment in mathematics teaching and learning;
- Understand the role of and demonstrate the effective use of appropriate technology in the teaching and learning of mathematics.

The masters' program in Teaching K-9 Mathematics is designed to promote professional and scholarly growth in the understanding of mathematics teaching and learning from theoretical, research, and practical orientations. This program is designed for certified teachers who desire an opportunity to advance their understanding of the teaching and learning of Mathematics. It is also intended for practicing teachers who wish to exercise leadership in school mathematics curriculum planning and teacher development. A copy of a current state teaching certificate must accompany the application.

General Admission Requirements for the Master of Arts in Teaching K-9 Mathematics Degree

1. A bachelor's degree.
2. Recommendations from three persons in the field of education, one of whom has known the student in a supervisory capacity.
3. Acceptance into the graduate program (see admission policies and procedures as stated elsewhere in this catalog).
4. **GRE**
5. Demonstration of entry-level competency on an inventory of content knowledge for teaching administered in the Mathematics Department.
6. Current teaching certificate.

Special requirements for Advancement to Candidacy

1. Completion of university requirements as listed in advancement to candidacy section as stated elsewhere in this catalog.
2. Selection of master's program committee members as stated elsewhere in this catalog. See approved third member policy.

Exit Requirements

1. Successful completion of all coursework and of a portfolio, written, and interview assessment process focused on a synthesis of course content.
2. Successful completion of the research report and final oral presentation.

Required (40 credits)

- EDUC 520 Methods of Educational Research (4)
- MATH 510 Number Sense for Teachers (3)
- MATH 511 Ratio and Proportion for Teachers (3)
- MATH 512 Geometric Reasoning for Teachers (3)
- MATH 513 Data Analysis and Probability for Teachers (3)
- MATH 514 Algebraic Reasoning for Teachers (3)
- MATH 515 Measurement for Teachers (3)
- MATH 528 Problem-Centered Learning (3)
- MATH 601 Research Report (6 credits minimum)
- MTED 524 Mathematics Curriculums in Elementary and Middle School (3)
- MTED 525 Assessment and Mathematics Learning (3)
- MTED 592 Theory and Research in Mathematics Education (3)

Electives (8 credits)

- EDUC 517 The Culture of Middle Level School (3)
- MATH 516 Calculus for Middle Level Teachers (4)
- MTED 526 Leadership in Mathematics Education (3)
- MTED 527 Technology in Mathematics Teaching and Learning (3)
- MTED 529 Topics in Mathematics Education (3) May be *repeated* with different topics, for example: a. Historical and Cultural Developments in Mathematics, b. Equity and Mathematics, c. History of Mathematics Education, d. Systems Theory and Learning, e. Lesson Study, f. Game Theory
- MTED 593 Pedagogical Development Studies (1) May be *repeated* for maximum of 3 credits.
- MTED 694 Mathematics Middle Level Teaching Internship (4)

Minimum total credits for above master's degree:

48 credits

Research Report

A master's research report should make an original and constructive contribution to the field of mathematics teaching and learning, at least in exposition if not in new understanding. To this end, a research report should demonstrate:

1. a mastery of a substantial body of mathematics content knowledge for teaching;
2. the ability to research and synthesize the literature on mathematics teaching and learning;
3. application of understanding in these areas by designing and conducting an applied research project in mathematics teaching and learning; and
4. the ability to present the research report clearly.

The final written description of the research report and its results must be in APA format.

Final Oral Presentation

(required for Master of Arts in Teaching K–9 Mathematics)

Each student shall complete a final oral presentation conducted by the chair of the candidate's master's program committee. The master's program committee will consist of two faculty members representing the interdisciplinary content of the student's program and a third member approved by the Graduate Office. The student will answer questions on his or her report posed by the committee. The final oral presentation will be open to all interested faculty and students and will be open to questions by outside members at the discretion of the committee.

GRADUATE CERTIFICATE FOR MIDDLE-LEVEL MATHEMATICS ENDORSEMENT (35-40 CREDITS)

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- understand and apply the mathematical processes of problem solving, reasoning, communicating and connecting; use varied representations to support and deepen mathematical understanding; and embrace technology as an essential tool for teaching and learning mathematics;
- demonstrate computational proficiency using various strategies, including a conceptual understanding of numbers, relationships among number and number systems and meanings of operations with all real numbers;
- understand relationships among quantities, functions and the analysis of change and demonstrate a conceptual understanding of and procedural facility with fundamental single variable calculus;
- use spatial visualization and geometric modeling to explore and analyze geometric figures and apply and use measurement concepts and tools;
- demonstrate an understanding of concepts and practices related to data analysis, statistics and probability and apply the fundamental ideas of discrete mathematics in the formulation and solution of problems;
- possess a deep understanding of how students learn mathematics and of the pedagogical knowledge specific to mathematics teaching and learning.

Through completion of the required courses in this certificate program, teachers currently certified in the state of Washington will earn a middle-level (4th through 9th grades) mathematics teaching endorsement. The MA in teaching K–9 mathematics program, with endorsement-specific electives completed, also meets the middle-level endorsement requirements, and students in the degree program need not enroll separately in this certificate program. The certificate program is for students seeking the endorsement only, without the master's degree, and differs from the undergraduate add-on middle level endorsement program in that the graduate courses will be populated by certified teachers who may have had teaching experience that they will bring to bear. The certificate program courses will also be offered in the late afternoons and summer quarters, whereas the courses in the undergraduate program are primarily offered during the day in the regular academic year.

Completion of this program—by a currently certified teacher with one or more Washington State teaching endorsements—will satisfy the Washington State requirements for a middle level mathematics teaching endorsement (grade levels 4–9).

General Admission Requirements for the Middle Level Mathematics Add-On Endorsement

1. A Washington State teaching certificate.
2. Demonstration of entry-level competency on an inventory of content knowledge for teaching mathematics administered in the Mathematics Department.

Required Courses

- EDUC 517 The Culture of Middle Level School (3)
- MATH 510 Number Sense for Teachers (3)
- MATH 511 Ratio and Proportion for Teachers (3)
- MATH 512 Geometric Reasoning for Teachers (3)
- MATH 513/413 Data Analysis and Probability for Teachers (3)
- MATH 514 Algebraic Reasoning for Teachers (3)
- MATH 515 Measurement for Teachers (3)
- MATH 516 Calculus for Middle Level Teachers (4)*
- MATH 528 Problem-Centered Learning (3)
- MTED 525 Assessment and Mathematics Learning (3)
- MTED 694 Mathematics Middle Level Teaching Internship (4)

Total credits for above program

35 credits**

* A pre-calculus I course or MATH 311 *Functions and Relations for K–8 Teachers* is a prerequisite for this course. **For students who have not previously completed a pre-calculus I course or MATH 311, the program will total 40 credits.

MASTER OF SCIENCE

Yves Nievergelt, Program Advisor | 127 Kingston Hall | 509.359.4259

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- demonstrate the ability to solve challenging in–depth mathematical problems;
- demonstrate the ability to learn advanced mathematics independently;
- demonstrate the ability to work effectively as a member of independent self-directed teams;
- demonstrate adaptability and flexibility to different contexts and situations;
- demonstrate the ability to effectively communicate mathematics research and exposition orally and in writing.

The Masters of Science program in mathematics is designed to meet the needs of students seeking employment in business and industry, those seeking careers in education at the elementary, secondary and post-secondary level, as well as students preparing for doctoral study in mathematics. The programs are rigorous and prepare the student for an increasingly competitive workplace. Graduates of these programs are highly successful professionals, scientists and teachers; many have earned doctorates.

The Master of Science curriculum includes core courses in algebra, complex analysis, real analysis and topology, courses on advanced topics; a research-expository thesis is required for all programs with the exception of the teaching options, which require a research report. Overall, the program is designed to develop competence in the central areas of mathematics, algebra, analysis and geometry, to such a point that the student can begin to see the profound interconnections between them. The thesis demands an in-depth study of a subject at or near the forefront of mathematics. Theses have been written in theoretical computer science, theoretical physics, applied mathematics and statistics, as well as pure mathematics; research reports focus on specific aspects of teaching mathematics at the high school or community college level. Well prepared entering undergraduates at Eastern Washington University may opt to combine the Master of Science program with the Bachelor of Arts in Mathematics in the Five-Year Bachelor of Arts/Master of Science in Mathematics program. Please consult the information in the undergraduate programs for mathematics listed above for the complete description of this program.

The department offers three options with the MS Mathematics program, as well as special interdisciplinary master of science programs. The Applied Mathematics option provides an opportunity to complete a year-long sequence of courses in an applied field and write a thesis on the use of mathematics in such a field. This applied option retains most of the theoretical courses from the Master of Science curriculum, which also form the foundations of applications, so that student retain the flexibility to pursue applied or teaching careers or further research in doctoral programs. To achieve such breadth and depth, however, this applied option may require up to one additional year to complete. The Community College Instruction option is specifically tailored for the needs of an individual seeking a profession in community college or junior college teaching. The Secondary School Instruction option is designed for high school teachers who wish to extend both their knowledge of mathematics and mathematics education. Both curricula include core graduate courses in mathematics and mathematics education, a research project and an internship. Interdisciplinary programs typically combine two fields (e.g., business and mathematics or computer science and mathematics); these programs are highly individualized and planned in conjunction with the two departments involved.

Graduate assistantships and graduate instructorships, with a partial tuition waiver, are available competitively to qualified applicants with a bachelor's degree in mathematics, mathematics education or equivalent. Graduate assistants receive approximately \$8,163 per academic year and typically teach one course per quarter. Instructors receive approximately \$14,346 per academic year and teach two courses per quarter. All graduate instructors are required to take a year-long, 3 credit methods course during their first year of instructorship.

Admission Requirements/Preparation

Entrance Requirements: In addition to applying for admission to the program, prospective MS students will need to apply for admission to the graduate school according to procedures described elsewhere in this catalog. The GRE general test is required for all graduate programs in mathematics. Expected preparation for MS students is a year of modern algebra along with introductory level courses in advanced calculus and topology.

Candidacy: Students who have been admitted and have begun their course of study should apply for admission to candidacy early in their program, using procedures described elsewhere in this catalog. Before candidacy can be approved, the student must remove all deficiencies regarding entrance requirements. Ordinarily, coursework taken to help meet the entrance requirements will not count toward fulfillment of the student's graduate program requirements. Upon admission to candidacy, the members of the student's graduate committee are selected.

Degree Requirements

Note: all mathematics graduate students who have been awarded a graduate service appointment with a teaching assignment must take MTED 521, 522 and 523.

Graduate Core (44 credits)

- MATH 531 Algebra I (4)
- MATH 532 Algebra II (4)
- MATH 533 Algebra III (4)
- MATH 551 General Topology I (4)
- MATH 561 Real Analysis I (4)*
- MATH 562 Real Analysis II (4)*
- MATH 573 Topics in Applied Mathematics (4)
- MATH 581 Complex Analysis I (4)*
- MATH 582 Complex Analysis II (4)*
- MATH 600 Thesis (8)

Other Supporting Credits (For teaching assistants only) (0–3 credits)

- MTED 521 Methods of Teaching Mathematics I (1)*
- MTED 522 Methods of Teaching Mathematics II (1)*
- MTED 523 Methods of Teaching Mathematics III (1)*

Electives—Additional mathematics courses (1–6 credits)

<i>Required graduate core credits</i>	<i>44 credits</i>
<i>Supporting credits</i>	<i>0–3 credits</i>
<i>Elective credits</i>	<i>1–6 credits</i>
<i>Minimum total credits for above master's degree</i>	<i>48 credits</i>

APPLIED MATHEMATICS OPTION (52 CREDITS)

Required Courses (40 credits)

- MATH 531 Algebra I (4)
- MATH 532 Algebra II (4)
- MATH 533 Algebra III (4)
- MATH 551 General Topology I (4)
- MATH 561 Real Analysis I (4)*
- MATH 562 Real Analysis II (4)*
- MATH 581 Complex Analysis I (4)*
- MATH 582 Complex Analysis II (4)*
- MATH 600 Thesis (8)

Elective (12 credits)

Twelve credits of applied courses approved by the Department of Mathematics Curriculum Committee. A thesis and a final comprehensive examination.

<i>Required option credits</i>	<i>40 credits</i>
<i>Elective credits</i>	<i>12 credits</i>
<i>Total credits for above master's degree</i>	<i>52 credits</i>

COMMUNITY COLLEGE INSTRUCTION OPTION (52 CREDITS)

Required Courses

- EDUC 520 Methods of Educational Research (4)
- MATH 531 Algebra I (4)
- MATH 532 Algebra II (4)
- MATH 551 General Topology (4)
- MATH 561 Real Analysis I (4)*
- MATH 562 Real Analysis II (4)*
- MATH 581 Complex Analysis I (4)*
- MATH 582 Complex Analysis II (4)*
- MATH 601 Research Report (8)
- MTED 521 Methods of Teaching Mathematics I (1)
- MTED 522 Methods of Teaching Mathematics II (1)
- MTED 523 Methods of Teaching Mathematics III (1)
- MTED 592 Theory and Research in Mathematics Education (3)
- MTED 695 Mathematics Education Internship (6)

Total credits for above master's degree *52 credits*

SECONDARY SCHOOL INSTRUCTION OPTION (50 CREDITS)

Required Courses (44 credits)

- EDUC 520 Methods of Educational Research (4)
- MATH 461 Advanced Calculus (4)
- MATH 470 Foundations of Geometry (4)
- MATH 531 Algebra I (4)
- MATH 551 General Topology (4)
- MATH 561 Real Analysis I (4)
or MATH 581 Complex Analysis I (4)
- MATH 601 Research Report (8)
- MTED 521 Methods of Teaching Mathematics I (1)
- MTED 522 Methods of Teaching Mathematics II (1)
- MTED 523 Methods of Teaching Mathematics III (1)
- MTED 592 Theory and Research in Mathematics Education (3)
- MTED 695 Mathematics Education Internship (6)

Two of the following, but only one MTED (6 credits)

- MATH 430 Advanced Linear Algebra (4)
- MATH 433 Introduction to Modern Algebra III (4)
- MATH 485 Theoretical Probability and Mathematical Statistics (4)
- MATH 486 Advanced Topics in Statistics (3) or approved upper division statistics course
- MATH 492 Problem Solving Seminar (5)
- MATH 532 Algebra II (4)
- MTED 493 Methods of Teaching Secondary Mathematics II (3)

Total credits for above master's degree *50 credits*

Master's Thesis

(Some options in the MS program in Mathematics require a research report instead of a thesis.)

A master's thesis in mathematics should make an original and constructive contribution to its field, at least in exposition if not in new mathematics. To this end, a thesis should demonstrate:

- a. a mastery of a substantial body of mathematics;
- b. the ability to search the mathematics literature; and
- c. a talent for presenting mathematics clearly in correct English.

Ideally, a master's thesis may establish a new result, but new results are not required. Instead, a thesis may present mathematics from other research works, in an exposition accessible to mathematicians who do not specialize in the topic of the thesis. The final version of the thesis may follow either a local format or a format required for submission to a professional mathematics journal.

Final Comprehensive Examination

(Required for all MS programs in mathematics.)

A two-hour final examination conducted by the chair of the candidate's graduate committee is required. The candidate will present his or her thesis or research report for the first hour. The remaining time is to be left for questions from the committee on the thesis as well as material selected from the candidate's coursework.

**Note:* certain mathematics courses will be offered every other year, alternating according to the following schedule:

Even numbered years: 342, 430, 445, 481, 486, 581, 582. *Odd numbered years:* 433, 447, 470, 485, 561, 562. 2010-2011 is an odd year; 2011-2012 is an even year.

Students need to take this into account when planning a program of study in the Department of Mathematics.

Mathematics Courses

Terms offered: fall, winter, spring, summer or alternate years (FWSU alt). If no terms are indicated check with the department or EagleNET.

MATH 100, 101, 102 Basic/Intermediate Algebra Combined (5, 5, 5) FWS

Does not count toward the 180 credit requirement.

Prerequisite for MATH 100: recommendation by advising or developmental mathematics coordinator.

Prerequisite for MATH 101 and 102: permission of instructor

MATH 100, 101, 102 is offered as a three-quarter sequence alternative to MATH 103A and B and 104A and B. Students who have a history of difficulty in mathematics may benefit from the slower pace of this course. Completion of MATH 100 and 101 with a grade of 2.0 or higher provides MATH 103A and B clearance and completion of MATH 102 with a grade of 2.0 or higher provides MATH 104A and B clearance.

MATH 103A Basic Algebra for College Students Part A (2.5) FWSU

Does not count toward the 180 credit requirement.

Topics include algebraic properties of number systems and the algebra of polynomials. This is a half-term course, after which successful students move on to MATH 103B (also a half-term course).

MATH 103B Basic Algebra for College Students Part B (2.5) FWSU

Does not count toward the 180 credit requirement.

Prerequisite: 2.0 or better in MATH 103A

Topics include algebraic properties of number systems, the algebra of polynomials, and algebraic, graphical and numerical solutions to equations of the first and second degree (including systems of linear equations, absolute value equations and literal equations). This is a half-term course, after which successful students move on to MATH 104A (also a half-term course).

MATH 104A Intermediate Algebra for College Students Part A (2.5) FWSU

Does not count toward the 180 credit requirement.

Prerequisite: 2.0 or better in MATH 103B, 2.0 or better in MATH 100 and 101. Appropriate score on math placement test or 2.0 in approved transfer course.

Topics are fundamentals of algebra, including linear and rational functions and equations. This is a half-term course, after which successful students move on to MATH 104B (also a half-term course).

MATH 104B Intermediate Algebra for College Students Part B (2.5) FWSU

Does not count toward the 180 credit requirement.

Prerequisite: 2.0 or better in MATH 104A.

This is a half-term course after which successful students satisfy the pre-university basic skills in mathematics. Topics are fundamentals of algebra, including quadratic and exponential functions and equations.

MATH 105 Precalculus I (5) FWSU

Prerequisite: MATH 114 or equivalent course or a 3.0 or better in MATH 104A and B or a satisfactory score on the mathematics placement test (MPT).

This course includes functions, graphing, polynomials, rational functions, logarithmic and exponential functions and complex numbers. Graphing calculators are used throughout the course.

MATH 106 Precalculus II (5) FWSU [For the university proficiencies, the course may be substituted for MATH 115.]

Prerequisite: MATH 105 or equivalent.

Trigonometric and inverse trigonometric functions, identities, complex numbers, sequences, series and mathematical induction. Graphing calculators are used throughout the course.

MATH 114 Algebra Concepts (5) FWSU [Completion of this course with a grade of 2.0 or better satisfies mathematics competency.]

Prerequisites: grade 3.0 or better in MATH 103A and B, or grade of 2.0 or better in MATH 104B, or a satisfactory score on the mathematics placement test (MPT).

This course introduces selected algebra topics with in-depth implementation of graphing and mathematical reasoning and is designed to give you the foundation necessary to continue in mathematics courses at EWU.

MATH 115 Mathematical Reasoning (5) FWSU [Completion of this course with a grade of 2.0 or better satisfies the university proficiencies in mathematics.]

Prerequisites: MATH 104B or equivalent course, or a satisfactory score on the mathematics placement test (MPT); Computer Literacy Competency recommended.

The course explores sets, basic logic, truth tables, elementary probability and statistics, geometry and the connections between mathematics and art, exponential functions, logarithms and geometric series. The spirit of the course is one of reasoning and problem solving. This is a terminal course intended for students not taking any other mathematics courses for their program of study. This proficiency may be satisfied by examination.

MATH 161 Calculus I (5) FWSU [For the university proficiencies, the course may be substituted for MATH 115.]

Prerequisites: MATH 106 and ENGL 100.

A review of the concepts of functions, absolute value, open and closed intervals and solutions of inequalities. Limits, derivatives of single variable functions and their applications, anti-derivatives, the definite integral.

MATH 162 Calculus II (5) FWS

Prerequisite: MATH 161.

Applications of the definite integral, inverse functions, transcendental functions, techniques of integration, improper integrals, Taylor's formula.

MATH 163 Calculus III (5) FWS

Prerequisite: MATH 162.

Polar coordinates, a brief treatment of conic sections, vectors, in \mathbb{R}^2 and \mathbb{R}^3 , parametric equations, introduction to partial differentiation, sequences and series.

MATH 196 Experimental Course (1-5)

MATH 199 Special Studies (1-5) FWS

Does not count toward the 180 credit requirement.

Prerequisite: permission of the instructor, department chair and college dean.

MATH 200 Finite Mathematics (5) FWS

[For the university proficiencies, the course may be substituted for MATH 115.]

Prerequisites: MATH 114 or equivalent course, or a 3.0 or better in MATH 104A and B, or a satisfactory score on the mathematics placement test (MPT); Computer Literacy Competency recommended; ENGL 100 or placement into or above ENGL 101.

This course provides an introduction to the mathematical systems encountered in the study of the behavioral sciences and a study of matrices, linear systems, linear programming, set theory and probability.

MATH 211 Structure of Elementary Mathematics I (5) FWSU

[For the university proficiencies, the completion of MATH 211 and 212 may be substituted for MATH 115.]

Prerequisites: MATH 114 or equivalent course, or a 3.0 or better in MATH 104A and B, or a satisfactory score on the mathematics placement test (MPT); ENGL 100 or placement into or above ENGL 101 on the EWU Writing Test.

This course is designed to give future K-8 teachers a basis for understanding elementary school mathematics. Topics include sets, number systems, functions and relations, operations on whole numbers, decimals and fractions, integers, percents, ratio and proportions and data analysis. There is a strong emphasis on conceptual understanding and problem solving.

MATH 212 Structure of Elementary Mathematics II (5) FWSU

[For the university proficiencies, the completion of MATH 211 and 212 may be substituted for MATH 115.]

Prerequisite: MATH 211.

The course is designed to give future K-8 teachers a basis for understanding elementary school mathematics. Course topics include probability (including simple and complex experiments and fundamental counting principles), geometry (including relationships, symmetry and transformations) and measurement. All topics are approached from theoretical and practical perspectives.

MATH 225 Foundations of Mathematics (5) FWS

Prerequisite: MATH 161. You may not receive credit for both MATH 225 and MATH 301.

Provides a transition from freshman-level to higher-level mathematics and is required for higher-level courses. Topics include logic, methods of proof, set theory, relations and functions and cardinality.

MATH 231 Linear Algebra (5) FWS

Prerequisite: MATH 106.

Theory and practice of vector geometry in \mathbb{R}^2 and \mathbb{R}^3 , systems of linear equations, matrix algebra, determinants, vector spaces, bases and dimension, linear transformations, rank and nullity and applications.

MATH 241 Calculus IV (5) FS

Prerequisite: MATH 163.

Differentiation of functions of several variables, multiple integrals, vector calculus. Should be taken as soon after Math 163 as possible.

MATH 297 Workshops, Short Courses, Conferences (3-5)

MATH 298 Seminar (1-5)

MATH 299 Special Studies (1-5) FWSU

Prerequisite: permission of the instructor, department chair and college dean.

MATH 301 Discrete Mathematics (5) FWS [For the university proficiencies, the course may be substituted for MATH 115.]

Prerequisite: MATH 105. You may not receive credit for both MATH 225 and MATH 301.

This course covers the theory and application of the mathematics most relevant to computer science. Foundation topics include logic, induction and recursion, methods of proof, set theory, relations and functions, and combinatorics. Implementation topics include graphs and matrices, including systems of linear equations, two dimensional rotation matrices and matrix representations of graphs, as well as selected topics in graph theory.

MATH 307 Mathematical Computing Laboratory III (1) FWS

Prerequisite: successful completion of the university computer literacy competency and permission of the instructor.

The laboratory consists of exercises, experiments and reports, using applications, calculators or mathematical software such as Maple, Mathematica, Matlab, MINITAB, Geometer's Sketchpad or SAS, on topics closely related to the contents of the designated concurrent mathematics course. However, the laboratory is not required by the designated course. The topics are specified in the section subtitles. (The laboratory may be repeated for credit.)

MATH 311 Functions and Relations for K-8 Teachers (5) FW

Prerequisites: MATH 114 or equivalent or satisfactory score on MPT, MATH 211 and MATH 212.

A discussion of the algebraic concepts of functions and relations from numeric, graphic and symbolic viewpoints.

MATH 312 Geometry for the K-8 Teacher (5) F

Prerequisite: MATH 311 or permission of the instructor; and (CPA 100 and CPA 101) or the equivalent.

Concepts from two- and three-dimensional geometry are explored and demonstrated. The course includes geometric proofs and requires the use of technology widely used in the K-12 system (and available in the Mathematics Department).

MATH 320 History of Mathematics (4) W

Prerequisites: ENGL 201; MATH 225 or permission of the instructor.

A historical development of mathematical ideas and methods. Emphasizes the individuals involved, the development of the intellectual activity called mathematics and the ebb and flow of mathematics in history.

MATH 341, 342, 343 Topics in Applied Analysis I, II, III (4, 4, 4)

Prerequisite: for MATH 341: MATH 163; for MATH 342 and 343: MATH 241.

Selected topics in applied mathematics such as vector analysis, complex variables, partial differential equations, etc.

MATH 345 Numerical Analysis I (4) W alt S alt

Prerequisites: junior or higher standing; MATH 225 and MATH 231 and a high-level computer language. (MATH 225 requires MATH 161)

The course develops numerical linear algebra and error estimates essential for scientific computing: machine arithmetic, algorithms for solving systems of linear equations, algorithms for computing eigenvalues and singular values (LU, QR, Jacobi's and SVD) and the theory of error estimates through condition numbers.

The course also includes such applications as the design and analysis of algorithms for floating-point arithmetic, linear regression, orthogonal linear regression, linear programming, or cubic splines, with applications to engineering and the sciences.

MATH 347 Introductory Differential Equations (4)
F alt, W alt

Prerequisite: MATH 163.

An introduction to ordinary differential equations, a nonrigorous, problem-solving approach including Laplace transforms and Fourier series with applications.

MATH 360 Continuous Functions (4) F

Prerequisites: MATH 163 and 225.

This course develops the topology of the n -dimensional real Euclidean space. Topics include the completeness of the real numbers, topological spaces, continuity and properties preserved by continuous functions, compactness and connectedness.

MATH 370 Survey of Geometries (5) S

Prerequisite: CPLA 100 and 101 or equivalent; and MATH 225.

Introduction to various finite and infinite geometries, both Euclidean and non-Euclidean. The logical notions of consistency, independence, interpretation and models and completeness will be explored. Properties and theorems of each geometric system will be developed synthetically, analytically and through use of technology.

MATH 380 Elementary Probability and Statistics (5) FWSU

Prerequisites: MATH 105 or Mathematics Proficiency Clearance, Computer Literacy Competency recommended.

[For the university proficiencies, course may be substituted for MATH 115.]

Empirical and theoretical frequency distributions. Discrete and continuous random variables. The binomial random variable and the normal. Descriptive statistics including measures of location, spread and association. An introduction to inferential statistics including confidence intervals and hypothesis testing.

MATH 383 Stochastic Processes (4)

Prerequisite: ENGR 321 and MATH 241, or permission of the instructor.

This course provides an introduction to the basic concepts of stochastic processes and its application to engineering problems. Topics include analysis of continuous and discrete random signals and systems, as well as modern estimation techniques.

MATH 385 Probability and An Introduction to Statistics (4) FW alt, S alt

Prerequisites: MATH 163, 225, Computer Literacy Competency recommended.

Mathematical theory of probability: proofs of simple theorems; Bayes' theorem and its applications to real world problems; discrete and continuous random variables; probability distributions for the binomial, geometric, Poisson, exponential and normal random variables; the distribution of the sample mean. Statistics: an introduction to confidence intervals and hypothesis testing.

MATH 386 Applied Statistics (4) W

Prerequisite: MATH 380 or MATH 385 or equivalent.

Statistical methods for research in the natural sciences. The course includes analysis of variance, multiple regression, analysis of covariance and nonparametric statistical procedures.

MATH 399 Special Studies in Mathematics (1-5)

FWSU

Prerequisite: permission of the instructor, department chair and college dean.

MATH 401 Advanced Formal Logic (5)

Prerequisites: PHIL 301 or math equivalent and successful completion of ENGL 101 and recommended placement above MATH 104B on the mathematics placement test or MATH 104B or equivalent.

Advanced study of formal deductive systems. Develops predicate logic on a rigorous basis, establishes some important metatheorems for logical systems and introduces some concepts in semantics and issues in the philosophy of logic.

MATH 407 Mathematical Computing Laboratory IV (1) FWS

Prerequisite: successful completion of the university computer literacy competency and permission of the instructor.

The laboratory consists of exercises, experiments and reports, using applications, calculators or mathematical software such as Maple, Mathematica, Matlab, MINITAB, Geometer's Sketchpad or SAS, on topics closely related to the contents of the designated concurrent mathematics course. However, the laboratory is not required by the designated course. The topics are specified in the section subtitles. (*The laboratory may be repeated for credit.*)

MATH 411 Discrete Mathematics for K-8 Teachers (4) W

Prerequisite: MATH 161 or 311

This course introduces the elementary mathematics major to the process of doing mathematics via mathematical proofs and mathematical reasoning. Throughout the course, familiar topics will be approached in a less intuitive, more formal way and in greater depth than previously experienced. Topics to be covered include logic; sets, functions and sequences; methods of proof; and combinatorics.

MATH 413 Data Analysis and Probability for Middle Level Teachers (3)

Prerequisites: MATH 212 and 311; MTED 390 and 412.

Through readings, discussion and a hands-on problem-centered approach, students will develop a profound understanding of concepts of data analysis and probability. Students will deepen their understanding of the research on the teaching and learning of data analysis and probability in K-9 mathematics.

MATH 416 Calculus for Middle Level Teachers (4)

Prerequisites: MATH 105 or MATH 311.

This course is intended for pre-service middle school teachers and focuses on conceptual and procedural understandings of limit, continuity, differentiation and integration. It includes the techniques and applications of calculus and use of technology to explore and represent fundamental concepts of calculus.

MATH 420 Problem Solving for K-8 Teachers (4)

FS

Prerequisite: MTED390 (or math teaching experience) and MATH 311 or equivalent course approved by the department and CPLA 100 and CPLA 101 or the equivalent.

This math content course for prospective K-8 teachers requires students enrolled in the class to solve a large variety of problem-solving problems using a variety of strategies including the use of manipulatives, technology and mathematical representations. Techniques for teaching problem solving are discussed in the course. The use of a variety of types of technology is a required component of the course.

MATH 430 Advanced Linear Algebra (4) S alt

Prerequisites: MATH 225 and 231.

Advanced study of linear algebra, including the structure theory of linear transformations, the Cayley-Hamilton Theorem and multilinear algebra.

MATH 431 Introduction to Modern Algebra I (4) F

Prerequisites: MATH 225, 231.

Sets, groups, cyclic and permutation groups, Lagrange's Theorem, quotient groups and the isomorphism theorems.

MATH 432 Introduction to Modern Algebra II (4)

W

Prerequisite: MATH 431.

Basic theory of rings and ideals. Polynomial rings, principal ideal domains and unique factorization domains. Modules.

MATH 433 Introduction to Modern Algebra III (4)

S alt

Prerequisite: MATH 432.

Field theory. Splitting fields, Galois groups, fundamental Theorem of Galois Theory. Applications to classical problems of Euclidean constructibility and solvability by radicals.

MATH 445 Numerical Analysis II (4) S even

Prerequisite: junior or higher standing; MATH 345.

The course combines numerical linear algebra with calculus to derive methods of scientific computing: numerical differentiation and integration, existence, uniqueness, stability and numerical approximation of solutions of nonlinear systems and of ordinary or partial differential equations, splines and fast Fourier or wavelet transforms.

The course also includes such applications to engineering and the sciences as the design and analysis of algorithms to compute special functions, computed geometric design, fluid dynamics, heat diffusion or financial Black-Scholes models, image processing or nonlinear regression.

MATH 447 Differential Equations (4) W alt

Prerequisites: MATH 225, 231 and 347.

Advanced study of differential equations including power series solutions, systems, numerical solutions and partial differential equations.

MATH 460 Continuous Functions (4) F

Prerequisites: MATH 163 and 225.

This course develops the topology of the n -dimensional real Euclidean space. Topics include the completeness of the real numbers, topological spaces, continuity and properties preserved by continuous functions, compactness and connectedness. Homework and examinations in MATH 460 focus more on designing proofs new to the student than they do in MATH 360.

MATH 461 Advanced Calculus I (4) W

Prerequisites: MATH 241 and 360 or MATH 460.

This course applies notions from linear algebra and continuous functions to develop the calculus of functions of several variables. Topics include differentiability, the derivative as a linear transformation, extreme value problems and the implicit and inverse function theorems.

MATH 462 Advanced Calculus II (4) S

Prerequisite: MATH 461.

This course builds on topics introduced in MATH 461 to treat integration. Topics include line integrals, exterior algebra and a general form of Stoke's Theorem, with selected applications to algebra, topology and fluid dynamics if time permits.

MATH 470 Foundations of Geometry (4) S alt

Prerequisite: MATH 225 and 231 or concurrent enrollment.

A treatment of plane Euclidean and projective geometries, including the theory of conics, utilizing analytic methods and linear algebra.

MATH 481 Complex Analysis (4) F alt

Prerequisite: MATH 360.

The algebra and calculus of complex functions. Series, holomorphic maps, Cauchy's Theorem, applications.

MATH 485 Theoretical Probability and Mathematical Statistics (4) S alt

Prerequisites: MATH 241, MATH 385.

Mathematical theory of probability; discrete and continuous multivariate distributions, moment generating functions, proof and application of the central limit theorem. Theory of statistical inference: topics in estimation and hypothesis testing; maximum likelihood estimates, the Neyman Pearson lemma, likelihood ratio tests. Other selected topics.

MATH 486 Advanced Topics in Statistics (3) F alt

Prerequisites: MATH 385, 386, 485.

Students will apply general theory from MATH 385, 386 and 485 to an area of statistics new to them. One or more advanced topics will be selected by the students in consultation with the instructor teaching the course, typically among the following: generalized linear models, categorical data analysis, time series analysis, survival analysis. The course will have a theoretical component dealing with mathematical aspects of the given topic(s), as well as a practical component typically taking form of a student project involving the analysis of a real-world data set.

MATH 492 Problem Solving Seminar (5) W
Prerequisites: MATH 225 or permission of the instructor; MATH 380 or MATH 385.

The course examines various problem solving strategies and techniques for teaching problem solving at the secondary level such as direct proof, indirect proof, inferences, mathematical representations and the use of technology.

MATH 494 Senior Seminar (2) W
Prerequisites: for students pursuing the BA in Mathematics; prior or concurrent enrollment in MATH 462 and 432; for students pursuing the BAE Secondary; prior or concurrent enrollment in MATH 360, 386, 432 and MTEd 493; for students pursuing the BA in Mathematics with a Computer Science option; prior or concurrent enrollment in MATH 360, 345 and 385.

The Senior Seminar course will explore the culture of mathematics through readings and classroom discussions. The students will be required to write a paper on some aspect of mathematics. At the same time, students will review the core mathematics they have studied and comprehensive tests will be administered in order to assess the knowledge they have acquired in their degree programs.

MATH 497 Workshops, Short Courses, Conferences (1-5)
 Selected topics to be arranged in consultation with the requesting organization.

MATH 498 Seminar (1-5)

MATH 499 Directed Study (1-5) FWSU
Prerequisite: permission of the instructor, department chair and college dean.

MATH 507 Mathematical Computing Laboratory (1)
Prerequisites: concurrent enrollment in or prior credit for a 500-level mathematics course designated by the Department of Mathematics each academic term.

The laboratory consists of exercises, experiments and reports, with applications or calculators or with such mathematical software as Maple, Mathematica, Matlab, MINITAB, Geometer's Sketchpad or SAS, on topics closely related to the contents of the designated concurrent mathematics course. However, the laboratory is not required by the designated course. The topics are specified in the section subtitles. (*The laboratory may be repeated for credit.*)

MATH 510 Number Sense for Teachers (3)
Prerequisite: graduate standing.

Through readings, discussion and a hands-on problem-centered approach, students will develop a profound understanding of the concepts of numeration systems, base ten and place value, operations, fractions, decimals, percents, integers, real numbers and number theory and will deepen their understanding of the research on the teaching and learning of these topics in K-9 mathematics. Major emphases will be learners' cognitive development through and across different grade levels, including that of diverse and exceptional learners, typical student conceptions and misconceptions, meaningful use of representations and technology in developing understanding and state and national standards related to these number-sense topics.

MATH 511 Ratio and Proportion for Teachers (3)
Prerequisite: graduate standing.

Through readings, discussion and a hands-on problem-centered approach, students will develop a profound understanding of the concepts of ratio and proportion and deepen their understanding of the research on the teaching and learning of ratio and proportion in K-9 mathematics. Major emphases will be learners' cognitive development through and across different grade levels, including that of diverse and exceptional learners, typical student conceptions and misconceptions, meaningful use of representations and technology in developing understanding and state and national standards related to ratio and proportion.

MATH 512 Geometric Reasoning for Teachers (3)
Prerequisite: graduate standing.

Through readings, discussion and a hands-on problem-centered approach, students will develop a profound

understanding of geometry concepts and deepen their understanding of the research on the teaching and learning of geometry concepts in K-9 mathematics. Major emphases will be learners' cognitive development through and across different grade levels, including that of diverse and exceptional learners, typical student conceptions and misconceptions, meaningful use of representations and technology in developing understanding and state and national standards related to geometry.

MATH 513 Data Analysis and Probability for Teachers (3)

Prerequisite: graduate standing.
 Through readings, discussion and a hands-on problem-centered approach, students will develop a profound understanding of concepts of data analysis and probability and deepen their understanding of the research on the teaching and learning of data analysis and probability in K-9 mathematics. Major emphases will be learners' cognitive development through and across different grade levels, including that of diverse and exceptional learners, typical student conceptions and misconceptions, meaningful use of representations and technology in developing understanding and state and national standards related to data analysis and probability.

MATH 514 Algebraic Reasoning for Teachers (3)
Prerequisite: graduate standing.

Through readings, discussion and a hands-on problem-centered approach, students will develop a profound understanding of algebraic reasoning and deepen their understanding of the research on the teaching and learning of algebraic reasoning in K-9 mathematics. Major emphases will be learners' cognitive development through and across different grade levels, including that of diverse and exceptional learners, typical student conceptions and misconceptions, meaningful use of representations and technology in developing understanding and state and national standards related to algebraic reasoning.

MATH 515 Measurement for Teachers (3)
Prerequisites: graduate standing.

Through readings, discussion and a hands-on problem-centered approach, students will develop a profound understanding of measurement concepts and deepen their understanding of the research on the teaching and learning of measurement in K-9 mathematics. Major emphases will be learners' cognitive development through and across different grade levels, including that of diverse and exceptional learners, typical student conceptions and misconceptions, meaningful use of representations and technology in developing understanding and state and national standards related to measurement.

MATH 516 Calculus for Middle Level Teachers (4)
Prerequisites: graduate standing and MATH 311 or equivalent.

This course is intended for middle school teachers and focuses on conceptual and procedural understandings of limit, continuity, differentiation and integration. It includes the techniques and applications of calculus and use of technology to explore and represent fundamental concepts of calculus. It also addresses the historical development of calculus and the contributions to its development from many cultures. Students will create a project focusing on connections between calculus, the middle school curriculum and current understandings of how students learn mathematics.

MATH 528 Problem-Centered Learning (3)
Prerequisite: graduate standing.

This course explores how to create classroom environments where rich tasks form the basis for mathematical learning. Special emphasis will be placed on task construction, selection and problem-posing. Participants will engage in a series of non-routine problem-solving activities. They will also be expected to develop non-routine problem-solving activities addressing specific mathematical ideas. These activities will serve as a basis for examining and reflecting on the research about and the implications of such an approach to the teaching and learning of mathematics.

MATH 531 Algebra I (4) F
Prerequisite: MATH 431 or permission of the instructor.

The theory of groups, starting at the Sylow Theorems. Topics: group actions, normal series, solvable and nilpotent groups, structure theorem for abelian groups, semidirect products, extensions.

MATH 532 Algebra II (4) W
Prerequisite: MATH 432 and 531 or permission of the instructor.

The theory of rings and modules. Topics: modules over principal ideal domains, Jacobson radical, chain conditions, Noetherian and Artinian rings, commutative algebra.

MATH 533 Algebra III (4) S
Prerequisite: MATH 532 or permission of the instructor.

The theory of fields and character theory. Topics: Galois theory, finite fields, cyclotomic extensions, transcendental extensions, group rings, Wedderburn's Theorem, Schur orthogonality relations.

MATH 539 Seminar in Special Topics (1-5)

MATH 551 General Topology I (4) F
Prerequisite: MATH 360 or 460 or a course in Topology.

Examines properties of abstract topological spaces and mappings including compactness and connectedness, conditions for metrizability.

MATH 561 Real Analysis I (4) W alt
Prerequisite: MATH 551.

This course presents the concepts of general measure and integration theory including the Lebesgue integral and its properties.

MATH 562 Real Analysis II (4) S alt
Prerequisite: MATH 561.

Examines the concept of derivative in a measure theoretic setting, as well as product measures and Fubini's theorem.

MATH 573 Topics in Applied Mathematics (4) F
Prerequisite: Graduate standing or permission of the instructor.

The course focuses on the mathematics of applications, depending on the interests of the class and the instructor. Topics will be specified in the section subtitle. (*This course may be repeated for credit.*)

MATH 581 Complex Analysis I (4) W alt
Prerequisite: MATH 551.

This course establishes the basic properties of holomorphic functions, including complex derivatives, power series, singularities, residues and the general integral formula of Cauchy. In particular, the course proves such classical results as the Fundamental Theorem of Algebra, the Open Mapping Theorem, the Maximum Principle and the theorems of Weierstrass, Montel or Looman-Menchoff. This course also presents examples of elementary conformal mappings, with optional applications to cartography or physics, from geometric or analytic points of view.

MATH 582 Complex Analysis II (4) S alt
Prerequisite: MATH 581.

Continues MATH 581 through the proofs of advanced results, such as the general Riemann Mapping Theorem, or properties of the special functions of Riemann and Weierstrass. If time permits, may include application to Algebraic Geometry, Number Theory and Coding or extensions to several complex variables, for example.

MATH 596 Experimental Course (1-5)

MATH 597 Workshops (1-5)
Note: only one workshop course for up to 3 credits may be used to fulfill graduate degree requirements.

MATH 598 Seminar (1-5)
Prerequisite: permission of the instructor.

MATH 599 Independent Study (1-6)
Prerequisite: permission of the instructor, department chair and college dean.

MATH 600 Thesis (1-15)
Prerequisite: permission of the instructor, department chair and college dean.

A research thesis under the direction of a graduate committee.

MATH 601 Research Report (1-15)
Prerequisite: permission of the instructor, department chair and college dean.

A research study in lieu of a bound thesis conducted as partial fulfillment of a master's degree in education under the direction of a graduate committee.

Mathematics Education Courses

Terms offered: fall, winter, spring, summer (FWSU). If no terms are indicated check with the department or EagleNET.

MTED 390 Methods of Teaching Elementary School Mathematics (5) FWSU

Prerequisites: MATH 211 and 212 or equivalent courses approved by the department; EDUC 303; junior standing.

Course designed to teach current methods for teaching math (grades K–8).

MTED 393 Methods of Teaching Secondary Mathematics I (3) S

Prerequisites: junior standing and concurrent enrollment in EDUC 413.

This course is designed to address the development and evaluation of select content and process standards: number sense, algebra, functions, representation, reasoning, and communication in the middle and high school. It includes the use of traditional, technological and manipulative materials consistent with current theory and practice.

Note: if through communication with your major and minor advisors you determine that taking MTED 393 concurrently with EDUC 413 will result in an overload, please contact the instructor of MTED 393.

MTED 412 Advanced Methods of Teaching K–8 Mathematics (5) FS

Prerequisites: MATH 311 and MTED 390 or MTED 493 or approval of the instructor; and CPLA 100 and CPLA 101 or the equivalent.

Advanced course in methods of teaching math (grades K–8), including the (required) use of technology. Focused on the teaching of topics in measurement, probability and statistics, algebraic reasoning, ratio and proportion and geometry.

MTED 490 Senior Capstone: Mathematics Practicum (5) FWS

Prerequisites: MATH 412 and MTED 390 and senior standing or MTED 393 and senior standing.

[satisfies senior capstone university graduation requirement]

This course is a practicum for students majoring in Mathematics Education. The students will do a pre-student teaching classroom experience in an elementary, middle or high school mathematics classroom (3 credits) and participate in a seminar (2 credits). Lessons will be planned and taught. Emphasis will be on putting educational theory into practice and reflecting on the process, particularly in the areas of problem solving, the NCTM Standards, use of manipulative materials and assessment. The course will fulfill the Senior Capstone Course requirement for the BAE Math/Elementary and BAE Math/Secondary majors.

MTED 493 Methods of Teaching Secondary Mathematics II (3)

Prerequisites: MTED 393, MATH 370 and MATH 380 or MATH 385. Concurrent: EDUC 341.

This course is designed to address the development and evaluation of select content and process standards—geometry, measurement, statistics, probability, problem solving, connections and communication in the middle and high school. The course includes the use of traditional, technological and manipulative materials consistent with current theory and practice.

Note: if through communication with your major and minor advisors you determine that taking MTED 493 concurrently with EDUC 341 will result in an overload, please contact the instructor of MTED 493.

MTED 521 Methods of Teaching Mathematics I (1) F

Prerequisites: concurrent enrollment in MATH 431 or 460 or 531.

MTED 521 is the first course in a three-sequence designed to expose mathematics graduate instructors to a variety of instructional techniques of teaching mathematics at the precollege and introductory college level. This course focuses on designing effective lessons.

MTED 522 Methods of Teaching Mathematics II (1) W

Prerequisites: MTED 521 or permission of instructor.

MTED 522 is the second course in a three-sequence designed to expose mathematics graduate instructors to a variety of instructional techniques for teaching mathematics at the precollege and introductory college level. This course focuses on developing effective questioning techniques and classroom discourse.

MTED 523 Methods of Teaching Mathematics III (1) S

Prerequisites: MTED 522 or permission of instructor.

MTED 523 is the third course in a three-sequence designed to expose mathematics graduate instructors to a variety of instructional techniques for teaching mathematics at the precollege and introductory college level. This course focuses on developing teaching select topics from the developmental mathematics curriculum and assessing student learning.

MTED 524 Mathematics Curriculum in Elementary and Middle School (3)

Prerequisite: graduate standing.

This course focuses on exploring the elementary and middle school mathematics curricula. The nature of mathematics, supporting research and curricular issues will be explored with an emphasis on implications for K–9 mathematics teaching and learning. Students will analyze both traditional and reform curricula. Special attention will be given to the research and theoretical bases underpinning these curricula.

MTED 525 Assessment and Mathematics Learning (3)

Prerequisite: graduate standing.

This course explores the relationship between assessment and mathematics learning. In particular, we will focus on the forms and purposes of assessment in the mathematics classroom, including the alignment of assessment to instruction, use of multiple sources of assessment information as evidence of learning and appropriate methods. Through readings, discussion and a hands-on problem-centered approach, students will extend their understanding of the research on assessment and the roles of assessment in K–9 mathematics classrooms.

MTED 526 Leadership in Mathematics Education (3)

Prerequisite: graduate standing.

The goals of this course are to understand issues around school-based leadership in mathematics education and to develop teacher-leaders who are content, pedagogical and diagnostic experts in their schools. Course readings, discussions and project topics include supporting professional learning communities; coaching for rigorous instruction and learning; creating equitable learning environments; assessment; teacher beliefs, knowledge and motivation; policy; reflecting on and measuring leader effectiveness; and teacher professional development.

MTED 527 Technology in Mathematics Teaching and Learning (3)

Prerequisite: graduate standing.

This course will explore the appropriate use of technology in mathematics education from philosophical, social, theoretical and pedagogical perspectives. It will provide perspectives on current and future trends and issues regarding the use of technology in mathematics teaching and learning. Students will use technology to solve mathematical problems, create mathematical demonstrations and construct new ideas of mathematics. Special attention is devoted to developing a deep understanding of the appropriate use of technology to explore and learn mathematics.

MTED 529 Topics in Mathematics Education (3)

Prerequisite: graduate standing.

This course includes topics regarding the teaching and learning of mathematics selected depending on the interest of the class and instructor. Possible topics may include (but are not limited to): history and culture of mathematics, history of mathematics education, systems theory and learning and equity. Topics will be specified in the section subtitle. (*This course may be repeated for credit with different topics.*)

MTED 590 Math Methods for Elementary Teachers (5)

Prerequisite: bachelor's degree or permission of instructor.

Designed to expose participants to a variety of instructional techniques for teaching mathematics concepts and skills at the K–8 level. Strengths and weaknesses of different techniques, such as lecture demonstration, small-group activities and problem solving are modeled and discussed.

MTED 592 Theory and Research in Mathematics Education (3)

Prerequisite: graduate standing.

This course is designed for graduate students in mathematics education who intend to pursue or further teaching careers. This course will explore the history of research in mathematics education; discuss various theories of mathematics learning; evaluate, synthesize and critique mathematics education research; and become acquainted with a diverse sample of quantitative and qualitative studies in mathematics education, as well as, with issue of current interest within the community. The course will be focused on issues that mathematics teachers should understand and investigate; including both content and research methods. In addition, students will be expected to select a mathematics content and/or pedagogical topic for particular emphasis in the course and conduct a research review. Students will leave the course with an understanding of the history of mathematics education research and of the use of research to inform teaching practice.

MTED 593 Pedagogical Development Studies (1)

Prerequisite: graduate standing.

This course is intended to enable participants in Mathematics Department-sponsored professional development programs to receive graduate credit through additional study. Specific course requirements will be tailored to the particulars of the professional development program but will include a minimum of one major and one minor research and writing assignment related to the development of content knowledge for the teaching of mathematics. (*May be repeated for a maximum of 3 credits.*)

MTED 694 Mathematics Middle Level Teaching Internship (4)

Prerequisites: four courses from the MATH 510 to MATH 516 series and either MTED 525 or MATH 528.

This course is a field experience in a middle level mathematics classroom. Candidates will demonstrate competency at designing and implementing mathematics instruction, guided by continuous formative assessment, that enables a broad diversity of learners to construct meaning, create and defend conjectures, solve problems, utilize procedures and notation and monitor their learning.

MTED 695 Mathematics Education Internship (6)

Prerequisites: graduate standing; permission of the instructor, department chair and college dean.

The theories of teaching and learning mathematics explored in the *Theory and Research in Mathematics Education* course (MATH 592) are made practically relevant in this course, as student teach classes such as MATH 211 or 212 while being mentored by faculty having experience with those classes. One-hour weekly seminars complement the in-class teaching assignment.