

# **Mathematics**

## **PROGRAM OBJECTIVES**

The program in mathematics has three primary objectives:

- To provide a major in mathematics that develops the attitude of mind and analytical skills required for effective use and understanding of mathematics.
- To provide a major which prepares students for a variety of career choices, including graduate study, industrial and business careers, and secondary school teaching. Within teaching, more generally, to prepare highly qualified teachers of mathematics for elementary, middle and secondary schools.
- To provide the necessary mathematical and statistical support courses for students in other disciplines, including computer science, physical and biological sciences, social science, business and economics, and health.

## **LEARNING OUTCOMES**

Graduates from the Mathematics Program will have demonstrated proficiency in the following four areas:

- *Content Knowledge*: demonstrate a broad-based knowledge of mathematical content and technique.

- *Problem Solving*: demonstrate problem-solving skills in the context of mathematics, and the ability to apply techniques learned in the study of specific topics in new areas.
- *Inquiry and Analysis*: employ the skills of independent, careful analysis of mathematical exposition.
- *Communication*: use written and oral communication skills appropriate to mathematical exposition.

### MEANS OF ASSESSMENT

Means of outcomes assessment include midterm and comprehensive final examinations, homework exercises and quizzes, individual and group projects, classroom presentations, term papers and a capstone project. For example, students generally demonstrate their mastery of fundamental areas of mathematics through performance on examinations. Skills in logical reasoning are demonstrated by constructing rigorous proofs of mathematical theorems, or constructing counterexamples if applicable. In addition to regular course work, problem solving skills may be demonstrated by participation in the Mathematical Contest in Modeling. Classroom presentations encourage students to develop skills in communicating mathematical ideas and subtleties to an audience of their peers. Finally, every graduating senior completes a capstone project in which the student's development in multiple areas is demonstrated.

### REQUIREMENTS FOR THE BACHELOR OF ARTS MATHEMATICS

- Complete the EOU BA graduation requirements.
- Completion of a minimum of 60 credit hours in Mathematics and affiliated courses as described below, including a minimum of 36 upper division credit hours in Mathematics.
- Complete each of the following mathematics core courses with a "C-" or better:

#### LOWER DIVISION CORE:

- CS 161** Foundations of CS I (4)
- MATH 251** Calculus I (4)
- MATH 252** Calculus II (4)
- MATH 253** Calculus III (4)
- MATH 254** Calculus IV (4)
- STAT 243** Elementary Statistics (4)

#### UPPER DIVISION CORE:

- MATH 311** Advanced Calculus (4)
- MATH 341** Linear Algebra (4)
- MATH 344** Modern Algebra I (4)
- MATH 382** Structure of Abstract Math (4)
- Either:**
- MATH 412** Real Analysis (4) or
- MATH 445** Modern Algebra II (4)
- MATH 407** Capstone Seminar (4)

#### UPPER DIVISION ELECTIVES:

- 12 credit hours of upper division mathematics courses.
- [For this purpose STAT 352 is considered a mathematics course.]

**Proposed Program Total: 60 credits**

### REQUIREMENTS FOR THE BACHELOR OF SCIENCE MATHEMATICS

- Complete the EOU BS graduation requirements.
- Completion of a minimum of 72 credit hours in Mathematics and affiliated courses as described below, including a minimum of 44 upper division credit hours in Mathematics.
- Complete each of the following mathematics core courses with a "C-" or better:

#### LOWER DIVISION CORE:

- CS 161** Foundations of CS I (4)
- CS 162** Foundations of CS II (4)
- MATH 251** Calculus I (4)
- MATH 252** Calculus II (4)
- MATH 253** Calculus III (4)
- MATH 254** Calculus IV (4)
- STAT 243** Elementary Statistics (4)

#### UPPER DIVISION CORE:

- MATH 311** Advanced Calculus (4)
- MATH 341** Linear Algebra (4)
- MATH 344** Modern Algebra I (4)
- MATH 382** Structure of Abstract Math (4)
- Either:**
- MATH 412** Real Analysis (4) or
- MATH 445** Modern Algebra II (4)
- MATH 407** Capstone Seminar (4)

#### UPPER DIVISION ELECTIVES:

- 20 credit hours of upper division mathematics courses.
- [For this purpose STAT 352 is considered a mathematics course.]

**Proposed Program Total: 72 credits**

### MATHEMATICS DEGREE

- Math electives must total at least 20 upper division mathematics credits (for the B.S. degree) or at least 12 upper division mathematics credits (for the B.A. degree). STAT 352 counts as a mathematics course for this purpose. (Additional advising information continues below)
- Students intending to continue into EOU's MAT program and/or pursue a career as a high school mathematics teacher are advised to include the following among their electives: MATH 323 (Mathematical Modeling), MATH 338 (Modern Geometry), MATH 355 (Advanced Discrete Mathematics), and MATH 361 (Probability and Statistics).
- Students interested in graduate studies in mathematics are advised to include the following among their electives: MATH 321 (Differential Equations), MATH 338 (Modern Geometry), and MATH 355 (Advanced Discrete Mathematics). In addition, such students should include both MATH 412 (Real Analysis) and MATH 445 (Modern Algebra II) within their 400-level courses.
- Students interested in a quantitative career in industry (such as an actuary, statistician, or data analyst) are advised to include the following among their electives: MATH 323 (Math Modeling), MATH 361 (Probability and Statistics), MATH 462 (Applied Regression Analysis), MATH 452 (Operations Research), and STAT 352 (Statistics).

**TYPICAL FIRST YEAR CURRICULUM**  
**MATHEMATICS** (beginning with MATH 095)

**TYPICAL FIRST YEAR CURRICULUM**

**Fall**

**MATH 095** Intermediate Algebra (4)  
General Education/Electives (8-11)

**Winter**

**MATH 111** College Algebra (4)  
General Education/Electives (8-11)

**Spring**

**MATH 112** Precalculus (4)  
General Education/Electives (8-11)

**TYPICAL SECOND YEAR CURRICULUM**

**Fall**

**MATH 251** Calculus I (4)  
**CS 161** Foundations of CS I (4)  
General Education/Electives (7-10)

**Winter**

**MATH 252** Calculus II (4)  
**CS 162** Foundations of CS II (4) (*BS degree only*)  
General Education/Electives (7-10)

**Spring**

**MATH 253** Calculus III (4)  
**STAT 243** Elementary Statistics (4)  
General Education/Electives (7-10)

**TYPICAL THIRD YEAR CURRICULUM**

**Fall**

**MATH 341** Linear Algebra (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**Winter**

**MATH 254** Calculus IV (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**Spring**

**MATH 382** Structures of Abstract Math (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**TYPICAL FOURTH YEAR CURRICULUM**

**Fall**

**MATH 311** Advanced Calculus (4) or  
**MATH 344** Modern Algebra I (4)  
**MATH 407** Capstone Seminar (1)  
MATH Elective (upper division)\* (4)  
General Education/Electives (5-9)

**Winter**

**MATH 412** Real Analysis (4) or  
**MATH 445** Modern Algebra (4)  
MATH Elective (upper division)\* (4)  
**MATH 407** Capstone Seminar (1)  
General Education/Electives (5-9)

**Spring**

**MATH 344** Modern Algebra I (4) or  
**MATH 311** Advanced Calculus (4)  
**MATH 407** Capstone Seminar (2)  
MATH Elective (upper division)\* (4)  
General Education/Electives (4-8)

**TYPICAL FIRST YEAR CURRICULUM**  
**MATHEMATICS** (beginning with College Algebra)

**TYPICAL FIRST YEAR CURRICULUM**

**Fall**

**MATH 111** College Algebra (4)  
General Education/Electives (8-11)

**Winter**

**MATH 112** Precalculus (4)  
**CS 161** Foundations of CS I (4)  
General Education/Electives (4-7)

**Spring**

**STAT 243** Elementary Statistics (4)  
**CS 162** Foundations of CS II (4) (*BS degree only*)  
General Education/Electives (4-7)

**TYPICAL SECOND YEAR CURRICULUM**

**Fall**

**MATH 251** Calculus I (4)  
General Education/Electives (11-14)

**Winter**

**MATH 252** Calculus II (4)  
General Education/Electives (11-14)

**Spring**

**MATH 253** Calculus III (4)  
General Education/Electives (11-14)

**TYPICAL THIRD YEAR CURRICULUM**

**Fall**

**MATH 341** Linear Algebra (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**Winter**

**MATH 254** Calculus IV (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**Spring**

**MATH 382** Structures of Abstract Math (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**TYPICAL FOURTH YEAR CURRICULUM**

**Fall**

**MATH 311** Advanced Calculus (4) or  
**MATH 344** Modern Algebra I (4)  
**MATH 407** Capstone Seminar (1)  
MATH Elective (upper division)\* (4)  
General Education/Electives (5-9)

**Winter**

**MATH 412** Real Analysis (4) or  
**MATH 445** Modern Algebra (4)  
MATH Elective (upper division)\* (4)  
**MATH 407** Capstone Seminar (1)  
General Education/Electives (5-9)

**Spring**

**MATH 344** Modern Algebra I (4) or  
**MATH 311** Advanced Calculus (4)  
**MATH 407** Capstone Seminar (2)  
MATH Elective (upper division)\* (4)  
General Education/Electives (4-8)

**TYPICAL FIRST YEAR CURRICULUM  
MATHEMATICS** (beginning with Calculus)

**TYPICAL FIRST YEAR CURRICULUM**

**Fall**

**MATH 251** Calculus I (4)  
**CS 161** Foundations of CS I (4)  
General Education/Electives (4-7)

**Winter**

**MATH 252** Calculus II (4)  
**CS 162** Foundations of CS II (4) (*BS degree only*)  
General Education/Electives (4-7)

**Spring**

**MATH 253** Calculus III (4)  
**STAT 243** Elementary Statistics (4)  
General Education/Electives (4-7)

**TYPICAL SECOND YEAR CURRICULUM**

**Fall**

**MATH 341** Linear Algebra (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (7-10)

**Winter**

**MATH 254** Calculus IV (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (7-10)

**Spring**

**MATH 382** Structures of Abstract Math (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (7-10)

**TYPICAL THIRD YEAR CURRICULUM**

**Fall**

**MATH 311** Advanced Calculus (4) or  
**MATH 344** Modern Algebra I (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**Winter**

**MATH 412** Real Analysis (4) or  
**MATH 445** Modern Algebra (4)  
MATH Elective (upper division)\* (4)  
General Education/Electives (6-10)

**Spring**

MATH Elective (upper division)\* (4)  
General Education/Electives (10-14)

**TYPICAL FOURTH YEAR CURRICULUM**

**Fall**

**MATH 311** Advanced Calculus (4) or  
**MATH 344** Modern Algebra I (4)  
**MATH 407** Capstone Seminar (1)  
MATH Elective (upper division)\* (4)  
General Education/Electives (5-9)

**Winter**

**MATH 412** Real Analysis (4) or  
**MATH 445** Modern Algebra (4)  
MATH Elective (upper division)\* (4)  
**MATH 407** Capstone Seminar (1)  
General Education/Electives (5-9)

**Spring**

**MATH 407** Capstone Seminar (2)  
MATH Elective (upper division)\* (4)  
General Education/Electives (8-12)

**REQUIREMENTS FOR THE MINOR IN MATHEMATICS**

- Completion of a minimum of 32 credits in mathematics.
- Complete the calculus sequence (**MATH 251**, 252, 253), Linear Algebra (**MATH 341**), and Structure of Abstract Math (**MATH 382**).
- Complete an additional 12 hours of mathematics courses number 231, 254 or upper division.
- Earn a grade of "C-" or better in **MATH 251**, 252, 253 and a minimum GPA of 2.00 in all other courses counting toward the minor.
- A minimum of 10 credits applied toward the minor must be completed at Eastern.

**REQUIREMENTS FOR THE MINOR IN  
MATHEMATICAL STUDIES** (multidisciplinary studies majors only)

- Complete the following courses:  
**MATH 211** Foundations of Elementary Mathematics I (4)  
**MATH 251** Calculus I (4)  
**MATH 252** Calculus II (4)  
**STAT 243** Elementary Statistics (4)  
**Either:**  
**MATH 338** Modern Geometry (4) or  
**MATH 382** Structures of Abstract Mathematics  
**CS 161** Foundations of CS I (4)  
**MTHE 333** Mathematics in Elem School (5)  
One mathematics course numbered 231, 254, or upper-division (4) Total (minimum) 33 CREDITS
- Complete each of the courses counting toward the minor with a grade of "C-" or better and an overall GPA of 2.00.
- A minimum of 10 credits applied toward the minor must be completed at EOU.

**REQUIREMENTS FOR THE MINOR IN  
STATISTICAL MATHEMATICS**

- Complete the following courses:  
**MATH 251** Calculus I (4)  
**MATH 252** Calculus II (4)  
**MATH 341** Linear Algebra (4)  
**STAT 243** Elementary Statistics (4) or  
**STAT 327** Stat & Exper Design (4)  
**STAT 352** Statistics (4)  
**MATH 361** Probability & Statistics (4)  
**MATH 462** Applied Regression Analysis (4)  
One additional upper division course of at least two credits approved by the student's adviser, this course should ideally be a course in the student's major in which statistics is used. Total (minimum) 30-31 credits.
- Complete each of the courses counting toward the minor with a grade of "C-" or better with an overall GPA of 2.00.
- A minimum of 10 credits applied toward the minor must be completed at EOU.

## MATHEMATICS COURSE DESCRIPTIONS

### **MATH 040 - Arithmetic Skill (Credits: 1 to 3)**

Designed for students who need review in basic computational skills. The course will deal with whole numbers, fractions, decimals, percentages, ratios, and introductory geometry. The class will require independent student effort, and students will have to motivate themselves to attend help sessions when needed. (Not applicable toward baccalaureate degree.)

### **MATH 070 - Elem Algebra (Credits: 4)**

Fundamental concepts of algebra. This course is equivalent to first year high school algebra. Concepts include solving equations, graphing equations and inequalities, and solving systems of equations. (Not applicable toward baccalaureate degree.)  
Prerequisite: MATH 040 or equivalent.

### **MATH 095 - Algebraic Foundations (Credits: 4)**

This course examines fundamental concepts of algebra and is equivalent to second year high school algebra. Concepts include polynomial expressions and factoring, rational expressions, radical expressions, and quadratic expressions. (Not applicable toward a baccalaureate degree.)  
Prerequisite: MATH 070 or equivalent.

### **MATH 105 - Lotteries & Loans\*SMI (Credits: 4)**

#### **Gen Ed Core-Natural, Math & Info Sciences**

This course is an introduction to certain areas of mathematics whose applications are important and whose study will help develop critical thinking skills. Two major topics are covered. One topic is the mathematics of finance, or "loans," which includes borrowing, saving, mortgages, leases and amortization and derivative securities. The other topic is "lotteries," which includes the elementary counting techniques including permutations and combinations, finite sample space probability theory, normal distributions and the Central Limit Theorem, and games of chance. Prerequisite: Math 095 or equivalent.

### **MATH 110 - MATH 110 (Credits: 1 to 6)**

Topics of current interest to students and faculty.

### **MATH 111 - College Algebra (Credits: 4)**

Topics examined in this course include equations and inequalities in one variable, a careful treatment of the function concept, and an examination of the properties and applications of several important families of functions: polynomial, rational, exponential and logarithmic. Prerequisite: MATH 095 or equivalent.

### **MATH 112 - Precalculus (Credits: 4)**

In this course students experience a detailed treatment of exponential, logarithmic, trigonometric and inverse trigonometric functions designed to prepare them for calculus. Prerequisite: MATH 111 or equivalent.

### **MATH 112a - Precalculus Part I (Credits: 2)**

This course is the first of a two-part course sequence to be offered. The two course sequence will be equivalent in credit and content to MATH 112

Precalculus. In this course, students experience a detailed treatment of exponential, logarithmic, trigonometric, and inverse trigonometric functions designed to prepare them for calculus. Prerequisite: MATH 111 or equivalent.

### **MATH 112b - Precalculus Part II (Credits: 2)**

This course is the second of a two-part course sequence to be offered. The two course sequence will be equivalent in credit and content to MATH 112 Precalculus. In this course, students experience a detailed treatment of exponential, logarithmic, trigonometric, and inverse trigonometric functions designed to prepare them for calculus. Prerequisite: MATH 112a or equivalent.

### **MATH 205 - Finite and Linear Mathematics\*SMI (Credits: 4)**

#### **Gen Ed Core-Natural, Math & Info Sciences**

This course surveys an array of non-calculus mathematical topics with contemporary applications to many fields, including business, natural sciences, and economics. Topics include elementary combinatorics and probability, vector and matrix arithmetic, exponential functions, and linear programming. Prerequisites: MATH 95 or placement in MATH 111.

### **MATH 209 - Field Placement (Credits: 1 to 15)**

A planned and supervised work experience involving mathematics at an introductory level, this course offers students an opportunity to examine career goals through a work experience with approved learning objectives.

### **MATH 210 - Selected Topics (Credits: 1 to 6)**

Topics of current interest to students and faculty.

### **MATH 211 - Found Elem Math I\*SMI (Credits: 4)**

#### **Gen Ed Core-Natural, Math & Info Sciences**

Introduction to basic concepts of elementary mathematics designed to initiate the building of an understanding and appreciation of the nature, structure, philosophy, and history of mathematics. Prerequisite: MATH 095.

### **MATH 212 - Found Elem Math II\*SMI (Credits: 4)**

#### **Gen Ed Core - Natural, Math & Info Sciences**

Introduction to basic concepts of elementary mathematics designed to initiate the building of an understanding and appreciation of the nature, structure, philosophy, and history of mathematics. Prerequisite: MATH 095.

### **MATH 213 - Found Elem Mth III\*SMI (Credits: 4)**

#### **Gen Ed Core-Natural, Math & Info Sciences**

Introduction to basic concepts of elementary mathematics designed to initiate the building of an understanding and appreciation of the nature, structure, philosophy, and history of mathematics. Prerequisite: MATH 095.

### **MATH 231 - Discrete Mathematics (Credits: 4)**

This course provides an introduction to several topics from Discrete Mathematics, including mathematical induction, Boolean logic and set operations, counting

theory (combinatorics), and graph theory.  
Prerequisite: MATH 111 or equivalent.

**MATH 239 - Surv Calculus Part I\*SMI (Credits: 2)**  
**Gen Ed Core-Natural, Math & Info Sciences**

This course is the first of a two part course sequence to be offered. The two course sequence will be equivalent in credit and content to MATH 241, Survey of Calculus. Topics cover an introductory look at the calculus of a small family of functions, primarily those encountered in high school algebra. Both differentiation and integration will be discussed together with applications of each. This course, only when combined with MATH 240, will meet the math competency requirement. Prerequisite: MATH 111 or equivalent.

**MATH 240 - Surv Calculus Part II\*SMI (Credits: 2)**  
**Gen Ed Core-Natural, Math & Info Sciences**

This course is the second of a two course sequence to be offered. The two course sequence will be equivalent in credit and content to MATH 241, Survey of Calculus. Topics cover an introductory look at the calculus of a small family of functions, primarily those encountered in high school algebra. Both differentiation and integration will be discussed together with applications of each. This course, only when combined with MATH 239, will meet the math competency requirement. Prerequisite: MATH 239 or equivalent.

**MATH 241- Survey Calculus\*SMI (Credits: 4)**  
**Gen Ed Core-Natural, Math & Info Sciences**

An introductory look at the calculus of a small family of functions primarily those encountered in high school algebra. Both differentiation and integration will be discussed together with applications of each. Prerequisite: MATH 111 or equivalent.

**MATH 251 - Calculus I\*SMI (Credits: 4)**  
**Gen Ed Core-Natural, Math & Info Sciences**

Differential Calculus including functions, limits, continuity, differentiation formulas, implicit differentiation, higher order derivatives, related rates, differentials, optimization problems, how the derivative affects the shape of a graph and an introduction to antiderivatives. Prerequisite: MATH 112.

**MATH 252 - Calculus II\*SMI (Credits: 4)**  
**Gen Ed Core-Natural, Math & Info Sciences**

Integral Calculus including the definite integral, the fundamental theorem of Calculus, area between curves, volumes by slicing, L'Hospital's Rule, the Calculus of the exponential and logarithmic functions, techniques of integration, improper integrals and arc length. Prerequisite: MATH 251.

**MATH 253 - Calculus III\*SMI (Credits: 4)**  
**Gen Ed Core-Natural, Math & Info Sciences**

Parametric equations and curves, Calculus with parametric curves, polar coordinates, conic sections, sequences, series, convergence tests for series, power series, Taylor and Maclaurin series, three dimensional coordinate system, vectors, dot product and cross product. Prerequisite: MATH 252.

**MATH 254 - Calculus IV\*SMI (Credits: 4)**  
**Gen Ed Core-Natural, Math & Info Sciences**

Multivariable Calculus including equations of lines and planes, cylinders and quadric surfaces, vector functions, Calculus of vector functions, functions of several variables, partial derivatives, the gradient vector, maximum and minimum values, iterated integrals, multiple integrals, cylindrical and spherical coordinates, triple integrals in cylindrical and spherical coordinates. Prerequisite: MATH 253.

**MATH 310 - Selected Topics (Credits: 1 to 6)**

Topics of current interest to students and faculty. Student must have at least sophomore standing to register for this course.

**MATH 311 - Advanced Calculus (Credits: 4)**

A careful examination of the calculus of single variable functions. Topics include limits, completeness and compactness, sequences and series, continuity and convergence of functions. Prerequisite: MATH 382. Student must have at least sophomore standing to register for this course.

**MATH 321- Differential Equations (Credits: 4)**

This course examines techniques of solution for ordinary differential equations including first order differential equations, linear differential equations of higher order, Euler's method, linear systems of differential equations and applications. Prerequisite: MATH 252. Student must have at least sophomore standing to register for this course.

**MATH 323 - Intro Math Modelings (Credits: 4)**  
**Institutional Graduation Requirement - UWR**

An introduction to the techniques of building and analyzing mathematical models. Discrete and continuous models in both scalar and vector systems are examined. Prerequisites: MATH 252 required, STAT 243 and MATH 341 recommended. Student must have at least sophomore standing to register for this course.

**MATH 338 - Modern Geometry (Credits: 4)**

A consideration of Euclid's parallel postulate and an introduction to non-Euclidean geometry. Prerequisite: MATH 252 or consent of instructor. Student must have at least sophomore standing to register for this course.

**MATH 341 - Linear Algebra (Credits: 4)**

An introduction to linear algebra including systems of linear equations, vector and matrix algebra, determinants, linear transformations, eigenvalues and eigenvectors, and the concepts of basis and dimension. Prerequisite: MATH 252 or consent of instructor. Student must have at least sophomore standing to register for this course.

**MATH 344 - Modern Algebra I (Credits: 4)**

An introduction to group theory. Topics covered include construction of examples, normal subgroups, factor groups, the homomorphism theorem, and group actions. Prerequisite: MATH 382. Student must have at least sophomore standing to register for this course.

**MATH 355 - Adv Top Discrete Math (Credits: 4)**

This course examines topics in discrete mathematics at an advanced level. Topics include set theory, relations, graph theory, analysis of algorithms, and enumeration. Prerequisite: MATH 252 or consent of instructor. Student must have at least sophomore standing to register for this course

**MATH 361 - Probability & Statistics (Credits: 4)**

In this course, students examine the foundation of elementary probability theory and statistics in both the discrete and continuous cases. Topics include probability density functions, moments and moment generating functions, random variables, samples and sampling distributions, estimation of parameters, and applications. Prerequisite: MATH 252 and STAT 243. Student must have at least sophomore standing to register for this course.

**MATH 382 - Structures Abstract Math (Credits: 4)  
Institutional Graduation Requirement - UWR**

This course provides an introduction to many topics used frequently in advanced courses, as well as a thorough introduction to proof techniques. The context includes elementary logic, naive set theory, number theory, and topology. Prerequisite: MATH 341 or consent of instructor. Student must have at least sophomore standing to register for this course.

**MATH 401 - Research (arranged) (Credits: 1 to 4)**

Individual research project selected with and supervised by a member of the mathematics faculty. Prerequisite: Consent of instructor.

**MATH 405 - Reading and Conf. (arranged)  
(Credits: 1 to 15)**

Student must have at least junior standing to register for this course.

**MATH 407 - Seminar/Capstone (Credits: 1 to 15)  
Institutional Graduation Requirement - UWR**

Student must have at least junior standing to register for this course.

**MATH 409 - Field Placement (Credits: 1 to 15)**

A planned and supervised work experience involving mathematics at an advanced level, this course offers students an opportunity to examine career goals through a work experience with approved learning objectives. Student must have at least junior standing to register for this course.

**MATH 410 - Selected Topics (Credits: 1 to 6)**

Student must have at least junior standing to register for this course.

**MATH 412 - Real Analysis (Credits: 4)**

A second term of advanced calculus covering the theory of derivatives and the Riemann integral. Prerequisite: MATH 311. Student must have at least junior standing to register for this course.

**MATH 445 - Modern Algebra II (Credits: 4)**

Continues the studies begun in MATH 344, extended by an introduction to rings and fields. Prerequisite: MATH 344. Student must have at least junior standing to register for this course.

**MATH 452 - Operations Research (Credits: 4)**

In this course, students examine linear optimization methods in mathematics. Topics include linear programming models, solution techniques, and sensitivity analysis. Prerequisite: MATH 252 and 341. Student must have at least junior standing to register for this course.

**MATH 462 - Applied Regression Analysis (Credits: 4)**

An introduction to statistical methods in regression and analysis of variance through the unifying theme of the general linear model Prerequisite: STAT 243 and MATH 341 required; STAT 352 recommended. Student must have at least junior standing to register for this course.

**MATH 483 - PDEs & Engineering Math (Credits: 4)**

A course covering advanced multi-variable and complex calculus together with partial differential equations. Topics include Fourier series, the heat and wave equations, analytic mappings of the complex plane, and other advanced mathematics commonly used in the fields of physics and engineering. Prerequisite: MATH 321 required and MATH 254 recommended. Student must have at least junior standing to register for this course.

**MATH 505 - Reading and Conf (arranged) (Credits: 1 to 15)**

Student must have graduate standing to register for this course.