MATHMATICS

Emphasis areas at the bachelor of science level include actuarial science, algebra/discrete mathematics, applied analysis, computational mathematics, secondary education, and statistics.

Mathematics is a universal language. It is one which scientists use to express ideas and relationships concisely. It is a tool, which they use to investigate problems.

As a mathematician, you will set up and analyze models of physical situations in order to deduce new information and to predict results.

Most students pursue their study of mathematics through a differential equations course and then elect courses in specialized areas such as algebra, analysis, geometry, topology, and statistics. Supporting study in technical electives is required from other departments. Such study includes analytical mechanics, communication theory, control theory, and others.

Your classes, for the most part, will be held in the Rolla Building. You will be provided data processing and computational services to solve complex problems through the computer facilities. (See computer science description.)

You will find that mathematics contributes to the growth in knowledge in most areas. Your program at Missouri S&T will emphasize breadth in mathematics and depth in an associated area of application.

Bachelor of Science
Applied Mathematics

A minimum of 128 credit hours is required for a bachelor of science degree in applied mathematics. A minimum grade of "C" is required by the department in each course counted toward the math/stat requirement for the B.S. in applied mathematics. Moreover, the department requires that an average of at least two grade points per credit hour must be obtained for all courses taken within the department. These requirements for the B.S. degree are in addition to credit received for algebra, trigonometry, and basic ROTC.

The applied mathematics curriculum requires fifteen semester hours of technical electives, except where this requirement is reduced to compensate for extra requirements of emphasis areas, in addition to basic courses in chemistry or biology, physics, computer science, and economics. Two semesters of language and communication, ENGLISH 1160 or ENGLISH 3560, and either HISTORY 1200, HISTORY 1300, HISTORY 1310, or POL SCI 1200 are also required. Specific requirements for the bachelor's degree are outlined in the sample program below.

### Freshman Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1101</td>
<td></td>
<td>MATH 1215 or 1221</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1208 or 1214</td>
<td></td>
<td>COMP SCI 1570, or 1970 and 1980, or 1971 and 1981, or 1972 and 1982</td>
<td>5</td>
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<tr>
<td>CHEM 1100</td>
<td></td>
<td>ENCON 1100 or 1200</td>
<td>3</td>
</tr>
<tr>
<td>ENGLISH 1120</td>
<td></td>
<td>Language and Communication Requirement</td>
<td>3</td>
</tr>
<tr>
<td>Campus History Requirement</td>
<td>3</td>
<td>Basic ROTC (if elected)</td>
<td>4</td>
</tr>
<tr>
<td>Language and Communication Requirement</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 128

1. A minimum grade of "C" is required by the department in each course counted toward the math/stat requirement for the B.S. in applied mathematics. Moreover, the department requires that an average of at least two grade points per credit hour must be obtained for all courses taken within the department.
2. May be met by HISTORY 1200, HISTORY 1300, HISTORY 1310, or POL SCI 1200.
3. This requirement will be satisfied by either (1) six credits of Speech and Media Studies course work; or (2) a modern language approved by the advisor with competency at the level of second semester college/university course work or, with approval of the department, by completion of Level III of a foreign language in high school.
4. Basic ROTC may be elected in the freshman and sophomore years, but is not creditable toward a degree. Up to six credit hours of advanced ROTC may be credited as free electives toward a degree.
5. May be met by CHEM 1310 and CHEM 1319 or by BIO SCI 1113 and BIO SCI 1219.
6. May be met by STAT 3115, STAT 3117, or STAT 5643.
7. No course may be used to satisfy more than one degree requirement, except as otherwise noted.
8. May be met by COMP SCI 1510, COMP SCI 1200 or COMP SCI 3200.
The student must choose two from the following five groups and then complete six hours in each of the chosen groups:

1. MATH 5105, MATH 5106, MATH 5107, MATH 5108
2. MATH 5105, MATH 5215, MATH 4530 or MATH 5530, MATH 5351, MATH 5585
3. MATH 5222, MATH 5302, MATH 5325, MATH 5351, MATH 5483, MATH 5603, MATH 5604
4. STAT 5814, STAT 5643, STAT 5644, STAT 5345, STAT 5753, STAT 5755, STAT 5756
5. COMP SCI 3200, COMP SCI 5201, COMP SCI 5202, MATH 5603, MATH 5604, MATH 5605, MATH 5606

Courses in chemistry, physics, mechanics, geology, computer science, economics or engineering approved by advisor. The general math curriculum requires 15 credit hours; actuarial science emphasis area, 12 credit hours; algebra/discrete math, 15 credit hours; computational math, 9 credit hours; statistics, 12 credit hours.

The capstone experience for all applied mathematics majors (other than students completing the secondary education emphasis area) consists of a course chosen from the following list: MATH 4098 (three credits), MATH 4099 or STAT 4099 (three credits), MATH 5107, MATH 5215, MATH 5603, STAT 5346, STAT 5353, STAT 5755, or STAT 5756.

COMP SCI 1570 if not transferred in will require COMP SCI 1580, requiring one extra credit hour which will count either towards technical electives or free electives.

May also be satisfied by ENGLISH 3560.

**Emphasis Areas at the Bachelor of Science Level**

**Actuarial Science Emphasis Area**

**Required courses:**

- STAT 5643: Probability And Statistics
- STAT 5644: Mathematical Statistics
- ECON 1100: Principles Of Microeconomics
- ECON 1200: Principles Of Macroeconomics
- ECON 2200: Intermediate Macroeconomic Theory
- MATH 5737: Financial Mathematics

And six hours from:

- STAT 5814: Applied Time Series Analysis
- STAT 5346: Regression Analysis
- STAT 5353: Statistical Data Analysis
- STAT 5755: Statistical Models in Actuarial Science
- STAT 5756: Statistical Models for Life Contingencies

In addition, the student must pass the first actuarial science exam. Note that the capstone requirement is included in, not separate from, this list of courses.

**Algebra/Discrete Mathematics Emphasis Area**

**Required courses:**

- MATH 5105: Modern Algebra I
- MATH 5106: Modern Algebra II
- MATH 5107: Combinatorics And Graph Theory
- MATH 5108: Linear Algebra II
- STAT 5643: Probability And Statistics

Select one of the following:

- STAT 5644: Mathematical Statistics
- COMP SCI 2200: Theory of Computer Science
- COMP SCI 3200: Introduction To Numerical Methods
- COMP SCI 5200: Analysis Of Algorithms

**Computational Mathematics Emphasis Area**

**Required courses:**

- STAT 5353: Statistical Data Analysis (Satisfies Capstone requirement)
- STAT 5346: Regression Analysis
- MATH 5603: Methods Of Applied Mathematics
- MATH 5604: Introduction To Numerical Methods For Differential Equations

Select three of the following:

- MATH 5302: Intermediate Differential Equations
- MATH 5325: Partial Differential Equations
- MATH 5603: Methods Of Applied Mathematics
- MATH 5604: Introduction To Numerical Methods For Differential Equations

Select one of the following:

- COMP SCI 3200: Computational Methods
- ELEC ENG 5760: Control Systems
- MATH 5604: Introduction To Numerical Methods For Differential Equations
- MATH 5605: Applied Numerical Methods
- MATH 5606: Applied Numerical Methods
- MATH 5607: Applied Numerical Methods

**Applied Analysis Emphasis Area**

**Required:**

- COMP SCI 3200: Introduction To Numerical Methods
- and two of groups 3, 4, and 5 under Mathematics and Statistics electives (plus the Capstone requirement) must be satisfied,
- and choose Technical Electives and Free Electives to satisfy one of the following two options:

**Engineering Option**

**Required courses:**

- CIV ENG 2200: Statics
- CIV ENG 2210: Mechanics Of Materials

Select one of the following:

- MECH ENG 2350: Engineering Mechanics-Dynamics
- MECH ENG 2360: Dynamics

Select three of the following:

- AERO ENG 3613: Aerospace Mechanics I
- AERO ENG 5313: Intermediate Dynamics Of Mechanical And Aerospace Systems
- AERO ENG 5614: Spaceflight Mechanics
- CHEM ENG 2100: Chemical Engineering Material & Energy Balances
- CHEM ENG 2110: Chemical Engineering Thermodynamics I
- ELEC ENG 2800: Electrical Circuits
- MECH ENG 3313: Machine Dynamics
- MECH ENG 2519: Thermodynamics or MECH ENG 2527: Heat Transfer
- MECH ENG 5131: Intermediate Thermofluid Mechanics
- NUC ENG 3103: Interactions Of Radiation With Matter
- NUC ENG 4203: Reactor Physics I
- PET ENG 4621: Fundamentals Of Petroleum Reservoir Simulation
- CIV ENG 3330: Engineering Fluid Mechanics or NUC ENG 322: Reactor Fluid Mechanics or MECH ENG 31 Thermofluid Mechanics I
- CIV ENG 5207: Computer Methods Of Structural Analysis
- CIV ENG 5333: Intermediate Hydraulic Engineering
- ELEC ENG 5370: Introduction To Neural Networks and Applications
A degree in this emphasis area requires 128 credit hours. The required courses and a sample four-year program are provided below. (A minimum grade of "C" is required by the department in all mathematics and statistics courses counted toward this degree. No course may be used to satisfy more than one degree requirement, except as otherwise noted.)

**Freshman Year**

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1110</td>
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<td>MATH 1215 or 1221</td>
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</tr>
<tr>
<td>MATH 1208 or 1214</td>
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<td>BIO SCI 1113</td>
<td>3</td>
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<td>CHEM 1100</td>
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<td>BIO SCI 1219 (Science Lab Requirement)</td>
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<tr>
<td>ENGLISH 1120</td>
<td>3</td>
<td>PSYCH 1101</td>
<td>3</td>
</tr>
<tr>
<td>HISTORY 1300 or 1310</td>
<td>3</td>
<td>EDUC 1164</td>
<td>2</td>
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<tr>
<td>EDUC 1040</td>
<td>2</td>
<td>EDUC 1174</td>
<td>2</td>
</tr>
<tr>
<td>EDUC 1104</td>
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<td><strong>Total Credits:</strong></td>
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<td><strong>Total Credits:</strong></td>
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**Sophomore Year**

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<tr>
<td>MATH 2222</td>
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<td>MATH 3304</td>
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<td>MATH 3108</td>
<td>3</td>
<td>MATH 3109</td>
<td>3</td>
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<tr>
<td>PHYSICS 1135 or 1111 and 1119</td>
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<td>ENGLISH 1160</td>
<td>3</td>
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<tr>
<td>COMP SCI 1570, or 1970 and 1980, or 1971 and 1981, or 1972 and 1982</td>
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<td>PHYSICS 2135 or 2111 and 2119</td>
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<tr>
<td>SP&amp;M S 1185</td>
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<td>PSYCH 3311</td>
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<td><strong>Total Credits:</strong></td>
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<td><strong>Total Credits:</strong></td>
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**Junior Year**

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<tr>
<td>MATH 4209</td>
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<td>MATH 4211</td>
<td>3</td>
</tr>
<tr>
<td>STAT 3115, or 3117, or 5643</td>
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<td>MATH 4530</td>
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<td>ECON 1100 or 1200</td>
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<td>EDUC 3280</td>
<td>6</td>
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<td>EDUC 2216</td>
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<td>Fine Art Elective</td>
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<td>ENGLISH 3170</td>
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<td>PSYCH 2300 or EDUC 2102</td>
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<td><strong>Total Credits:</strong></td>
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**Senior Year**

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<th>Second Semester</th>
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<tbody>
<tr>
<td>Electives-Math or Stat</td>
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<td>EDUC 4298 &amp; EDUC 4299</td>
<td>13</td>
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<tr>
<td>PSYCH 4310 or EDUC 4310</td>
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<tr>
<td>POL SCI 1200</td>
<td>3</td>
<td></td>
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<tr>
<td>Literature</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits:</strong></td>
<td>17</td>
<td><strong>Total Credits:</strong></td>
<td>13</td>
</tr>
</tbody>
</table>

Total Credits: 128

1. May be met by BIO SCI 1219 or CHEM 1319, but if CHEM 1319 is used, one extra hour must be attained in any elective area to fulfill the 128 total hour requirement.
2. Any three-hour course from the areas of foreign language, music, theater, philosophy or art.
3. Student Teaching satisfies the capstone requirement for students completing this emphasis area.
4. p=Any two three-hour courses from the following list with the approval of the mathematics education advisor. MATH 5302, MATH 5105, MATH 5106, MATH 5107, MATH 5108, MATH 5215, MATH 5222, MATH 5325, MATH 5351, MATH 5483, MATH 5585, STAT 5643, STAT 5644, STAT 5346, STAT 5353, COMP SCI 3200, COMP SCI 5201, COMP SCI 5202, MATH 5737.
5. COMP SCI 1570 if not transferred in will require COMP SCI 1580, requiring one extra credit hour which will count either towards technical electives or free electives.

**Statistics Emphasis Area**

**Required courses:**

| STAT 5643 | Probability And Statistics | 3 |
| STAT 5644 | Mathematical Statistics | 3 |
| STAT 5346 | Regression Analysis | 3 |
| STAT 5353 | Statistical Data Analysis (Satisfies Capstone requirement) | 3 |

Select two of the following:

| BIO SCI 2223 | General Genetics | 3 |
| COMP SCI 3200 | Introduction To Numerical Methods | 3 |
| COMP SCI 5402 | Data Mining & Machine Learning | 3 |
| STAT 5260 | Statistical Data Analysis Using SAS | 3 |
| STAT 5814 | Applied Time Series Analysis | 3 |

And complete either A or B:

- **A:**
  - STAT 5814: Applied Time Series Analysis
  - STAT 5260: Statistical Data Analysis Using SAS

- **B:**
  - STAT 5260: Statistical Data Analysis Using SAS
  - STAT 5814: Applied Time Series Analysis

**Note that the requirements for a minor in physics will be satisfied with this option.**
(A) Complete the following 2 courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>MATH 5215</td>
<td>Introduction To Real Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MATH 5351</td>
<td>Introduction To Complex Variables</td>
<td>3</td>
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</table>

(B) Complete 6 hours from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 5107</td>
<td>Combinatorics And Graph Theory</td>
<td>3</td>
</tr>
<tr>
<td>MATH 5108</td>
<td>Linear Algebra II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 5603</td>
<td>Methods of Applied Mathematics</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: It is not required that students complete an emphasis area to obtain the bachelor of science degree in applied mathematics. The emphasis area requirements often specify most, if not all, of the electives in mathematics, statistics and computer science as well as many technical or free electives.

Bioinformatics Minor

Students majoring in mathematics are eligible to pursue a minor in bioinformatics. See the description of the bioinformatics minor (http://catalog.mst.edu/undergraduate/degreeprogramsandcourses/bioinformaticsminor).

Mathematics Minor Curriculum

The minor will consist of at least 12 hours of mathematics/statistics courses at the 3000 or higher level*, 9 hours of which must be completed in residence at Missouri S&T and 3 hours of which must be at the 4000 or higher level, and passing all of them with at least a grade of “C”. Further, MATH 3304 and MATH 3329 cannot both be counted, MATH 3103 and MATH 3108 cannot both be counted, and at most one of STAT 3111, STAT 3113, STAT 3115 and STAT 3117 may be counted. Finally, the specific choice of courses is subject to the approval of the minor advisor.

* COMP SCI 3200 Introduction To Numerical Methods may be substituted for one of these courses.

Akim Mouhamadou Adekpedjou, Associate Professor  
PHD University of South Carolina Columbia

Elvan Akin, Associate Professor  
PHD University of Nebraska Lincoln

Martin Bohner, Curators’ Distinguished Professor  
PHD University of Ulm, Germany

Wlodzimierz Jan Charatonik, Professor  
PHD University of Warsaw, Poland

Stephen L Clark, Professor  
PHD Univ. of Tennessee-Knoxville

Stephanie L Fitch, Associate Teaching Professor  
MA University of Texas-Austin

David E Grow, Associate Professor  
PHD University of Nebraska Lincoln

Xiaoming He, Associate Professor  
PHD Virginia Polytechnic Institute

Wenqing Hu, Assistant Professor  
PHD University of Maryland-College Park

Eugene M Insall Jr, Associate Professor  
PHD University of Houston

Nan Jiang, Assistant Professor  
PHD University of Pittsburgh

Kimberly S Kinder, Assistant Teaching Professor  
MS Central Missouri State University

Vy Khoi Le, Professor  
PHD University of Utah

Gayla Renee Olbricht, Assistant Professor  
PHD Purdue University

Robert L Paige, Professor  
PHD Colorado State University

Robert Paul Roe, Associate Professor  
PHD University of Wyoming

Paul N Runnion, Assistant Teaching Professor  
MS University of Missouri-Rolla

V A Samaranayake, Curators’ Distinguished Teaching Professor  
PHD Kansas State University

John R Singler, Associate Professor  
PHD Virginia Polytechnic Institute

Xuering (Meggie) Wen, Associate Professor  
PHD University of Minnesota

Yanzhi Zhang, Assistant Professor  
PHD National University of Singapore

Peizhen Zhu, Assistant Teaching Professor  
PHD University of Colorado-Denver

MATH 1000 Special Problems (IND 0.0-6.0)  
Problems or readings in specific subjects or projects in the department. Consent of instructor required.

MATH 1001 Special Topics (LEC 0.0 and LAB 0.0)  
This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 1101 Introduction To Mathematics (LEC 1.0)  
Introduction to the department, program of study, methods of study, and an introduction of the various areas of mathematics. Required of fall semester freshman mathematics majors.

MATH 1103 Fundamentals Of Algebra (LEC 3.0)  
Basic principles of algebra including the number line and an introduction to equations and inequalities, polynomials, rational expressions, exponents and radicals, the quadratic formula and functions. Prerequisite: Entrance requirements.

MATH 1110 Introduction To Mathematical Ideas (LEC 3.0)  
A course for non-science majors, including liberal arts and education majors. A study of the nature of mathematics and its relation to western culture, number systems, sets, functions, and selected topics from algebra, computer science and other areas of mathematics. Prerequisite: Two years high school mathematics.

MATH 1120 College Algebra (LEC 5.0)  
Contains the same topics as covered in Math 1140, and preceded by a thorough review of the basic principles of algebra. Prerequisite: By placement examination.
MATH 1140 College Algebra (LEC 3.0)
A study of linear equations, rational functions, radicals, quadratic equations, inequalities, determinants, progressions, theory of equations, permutations, combinations, and the binomial theorem. Prerequisite: By placement examination.

MATH 1160 Trigonometry (LEC 2.0)
A study of the trigonometric functions, radian measure, graphing trigonometric functions, identities, trigonometric equations and inverse trigonometric functions. Solutions of general triangles and trigonometric representation of complex numbers are included. Prerequisite: Math 1120 or 1140 with a grade of "C" or better; or by placement exam.

MATH 1190 Success for Calculus (LEC 3.0 and LAB 1.0)
This course focuses on the use of college algebra and trigonometry skills within the context of calculus, providing students with the opportunity to improve their preparedness for future calculus coursework. Pass/Fail only. Prerequisites: Consent of instructor.

MATH 1208 Calculus With Analytic Geometry I (LEC 5.0)
A study of limits, continuity, differentiation and integration of algebraic and trigonometric functions. Applications of these concepts in physical as well as mathematical settings are considered. Credit will only be given for one of Math 1208 or Math 1214. Prerequisites: Math 1160; Math 1120 or 1140, both with a grade of "C"; or better; or by placement exam.

MATH 1212 Business Calculus (LEC 3.0 and LAB 1.0)
Calculus for Bus. & Mgt. Sys, Econ & Finance, or Info. Sci. & Tech; also possibly Bio. Sci, Soc. Sci. or Humanities. Derivatives, optimization, exponential and logarithmic functions, integration, multivariate functions, partial derivatives, Lagrange multipliers, applications. May not be used as a prerequisite for either Math 1215 or Math 1221. Prerequisite: A grade of "C" or better in either 1120 or Math 1140; or by placement exam.

MATH 1214 Calculus For Engineers I (LAB 1.0 and LEC 3.0)
Introduction to limits, continuity, differentiation and integration of algebraic and elementary transcendental functions. Applications in physical science and engineering. Credit will be given for only one of Math 1208 or Math 1214. Math 1214 may be accompanied by Math 1160 with Math department approval. Prerequisites: A grade of "C" or better in both Math 1160 and one of Math 1120 or Math 1140; or by placement exam.

MATH 1215 Calculus For Engineers II (LAB 1.0 and LEC 3.0)
Continuation of Math 1214. Transcendental functions, techniques of integration, sequences, series including power series, polar coordinates, and parametric equations. Applications in physical science and engineering. Credit will be given for only one of Math 1215 or Math 1221. Prerequisites: Math 1160 and either Math 1208 or Math 1214 both with a grade of "C" or better; or by placement exam.

MATH 1221 Calculus With Analytic Geometry II (LEC 5.0)
A continuation of Math 8; differentiation and integration of elementary transcendental functions, integration techniques, improper integrals, conic sections, polar coordinates, introduction to sequences and series. Credit will only be given for one of Math 1221 or Math 1215. Prerequisites: Math 1160 and either Math 1208 or Math 1214 both with a grade of "C" or better; or by placement exam.

MATH 2002 Cooperative Work Training (IND 0.0-6.0)
On-the-job experience gained through cooperative education with industry. Variable credit arranged with the advisor. P/F grading option is required and maximum credit per semester is 3 hrs., maximum for entire program is 6 hrs.

MATH 2222 Calculus with Analytic Geometry III (LEC 3.0 and LAB 1.0)
An introduction to multivariable calculus. Vector valued functions, curves and surfaces in two and three dimensions, partial differentiation, multiple integration, line and surface integrals, the major theorems of vector calculus, and applications of these ideas are studied. Prerequisites: Math 1215 or Math 1221 with a grade of "C" or better.

MATH 3000 Special Problems (IND 0.0-6.0)
Problems or readings in specific subjects or projects in the department. Consent of instructor required.

MATH 3001 Special Topics (IND 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 3010 Undergraduate Seminar (SEM 1.0-3.0)
Discussion of advanced or current topics. (Course cannot be used for graduate credit).

MATH 3103 Matrix Algebra (LEC 3.0)
Matrix algebra is introduced by means of systems of linear algebraic equations. Gaussian elimination, least squares solutions, orthogonalization, determinants, eigenvalues and an introduction to vector spaces are discussed. Credit will not be given for both Math 3103 and 3108. Prerequisite: Math 2222 with a grade of "C" or better.

MATH 3108 Linear Algebra I (LEC 3.0)
Systems of linear equations, matrices, vector spaces, inner products, linear transformations, determinants, and eigenvalues are studied. Prerequisite: Math 1215 or 1221 or 2222 with a grade of "C" or better.

MATH 3109 Foundations Of Mathematics (LEC 3.0)
Introduction to mathematical reasoning through an axiomatic development of mathematical systems. Strong emphasis is placed on learning to understand what constitutes a sound mathematical argument. Communication, both written and spoken, is emphasized. Prerequisite: Math 1215 or 1221 with a grade of "C" or better.

MATH 3304 Elementary Differential Equations (LEC 3.0)
First order differential equations and linear differential equations of higher order are studied. The Laplace transform and systems of linear equations as well as selected physical applications are covered. Credit will not be given for both Math 3329 and Math 3304. Prerequisite: Math 2222 with a grade of "C" or better.

MATH 3329 Elementary Differential Equations And Matrix Algebra (LEC 3.0)
This course is a combination of selected topics from Math 3103 and 3304. Solutions of linear differential equations and systems of linear algebraic equations are emphasized. Credit will not be given for both Math 3329 and 3329. Prerequisite: Math 2222 with a grade of "C" or better.

MATH 3321 Teaching Math in Elementary and Middle Schools (LEC 3.0)
The course presents an overview of how children learn mathematics, various techniques in teaching mathematics, and examples of applying these techniques to specific mathematical concepts (such as geometry, measurement, basic operations, statistics and probability, etc.). Prerequisite: Math 1120 or Math 1140. (Co-listed with Educ 3221).

MATH 3322 Geometric Concepts for Elementary Teachers (LEC 3.0)
The course covers methods of teaching the study of points, lines, polygons, similarity, congruence, constructions, and proof in Euclidean Plane Geometry. Transformational geometry and trigonometry are introduced to elementary teachers. Prerequisites: Math 1120 or Math 1140. (Co-listed with Educ 3222).
MATH 3940 Mathematical Software Applications In The Classroom (LEC 3.0)
Students will be introduced to a variety of Mathematical Software applications, both PC and calculator based which will aid teachers in presenting concepts and in classroom management. Specific topics covered will be selected based on student interest. Prerequisites: Math 2222 and admission to the MST program.

MATH 4000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

MATH 4001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 4010 Undergraduate Seminar (SEM 1.0-3.0)
Discussion of advanced or current topics. (Course cannot be used for graduate credit).

MATH 4096 Problem Solving In Pure Mathematics (LEC 1.0)
Problems from pure mathematics, including analysis, algebra, number theory, set theory, finite mathematics, probability and statistics. Emphasis on identifying or inventing ways to solve problems based on the student's entire mathematics background. Prerequisites: Corequisite Math 4209 and Senior standing.

MATH 4097 Problem Solving In Applied Mathematics (LEC 1.0)
Problems from applied mathematics which are open-ended, and do not always have a unique correct solution. Emphasis on developing mathematical models and writing solution narratives, including clarity, analysis, and design. Prerequisites: Math 3109 and Senior standing.

MATH 4098 Explorations in Pure Mathematics (LEC 3.0)
Students interested in pure mathematics will be encouraged to use their entire mathematics background as a context for learning about some of the great theorems which have shaped the development of mathematics and solving novel problems in areas such as, but not limited to, analysis, algebra, number theory, set theory, topology, and finite mathematics. Prerequisites: Senior standing; preceded or accompanied by Math 4209.

MATH 4099 Undergraduate Research (IND 0.0-6.0)
This course is designed for the undergraduate student who wishes to engage in research. It is not to be used for graduate credit nor for more than six credit hours of undergraduate credit. The subject and credit are to be arranged with the instructor. Prerequisite: Consent of instructor.

MATH 4209 Advanced Calculus I (LEC 3.0)
Completeness of the set of real numbers, sequences and series of real numbers, limits, continuity and differentiability, uniform convergence, Taylor series, Heine-Borel theorem, Riemann integral, fundamental theorem of calculus, Cauchy-Riemann integral. Prerequisite: Math 2222 and Math 3109, or a 4000-level or higher mathematics course, or graduate standing.

MATH 4211 Advanced Calculus II (LEC 3.0)
Euclidean n-space, differentiation and integration of scalar functions of several variables, maxima and minima theory, change of variables, differentiation and integration of vector functions of several variables, divergence theorem, Stokes' theorem. Prerequisite: Math 4209.

MATH 4530 Topics In Geometry (LEC 3.0)
A survey of non-Euclidean geometries, finite geometries, affine and projective planes, metric postulates for the Euclidean plane, and selected topics. Credit will not be given for both Math 4530 and Math 5530. Prerequisites: MATH 3108.

MATH 5000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

MATH 5001 Special Topics (IND 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

MATH 5010 Graduate Seminar (SEM 1.0)
Discussion of advanced or current topics.

MATH 5040 Oral Examination (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

MATH 5099 Graduate Research (IND 0.0-6.0)
Investigation of an advanced nature leading to the preparation of a MS thesis or dissertation.

MATH 5105 Modern Algebra I (LEC 3.0)
Equivalence relations and functions, basic properties of groups, subgroups, permutations, cosets and Lagrange's Theorem, homomorphisms and isomorphisms, factor groups. Prerequisite: Math 3109 or graduate standing; preceded or accompanied by Math 3108.

MATH 5106 Modern Algebra II (LEC 3.0)
This course is a continuation of Math 5105. Rings and fields are discussed. Euclidean domains, principal ideal domains, unique factorization domains, vector spaces, finite fields and field extensions are studied. Prerequisite: Math 5105.

MATH 5107 Combinatorics And Graph Theory (LEC 3.0)
Covers some basics of enumeration and graph theory. Topics are selected from the following: permutations combinations, the inclusion/exclusion principle, generating functions, recurrence relations, trees, networks, graph connectivity and graph coloring. Prerequisite: Comp Sci 1200 or Math 3109.

MATH 5108 Linear Algebra II (LEC 3.0)
Eigenvalue problems, Cayley-Hamilton theorem, Jordan normal form, linear functionals, bilinear forms, quadratic forms, orthogonal and unitary transformations, selected applications of linear algebra. Prerequisite: Math 3108.

MATH 5154 Mathematical Logic I (LEC 3.0)
A mathematical introduction to logic with some applications. Functional and relational languages, satisfaction, soundness and completeness theorems, compactness theorems. Examples from Mathematics, Philosophy, Computer Science, and/or Computer Engineering. Prerequisite: Philos 3254 or Math 5105 or Comp Sci 2500 or Comp Eng 2210. (Co-listed with Comp Eng 5803, Comp Sci 5203 and Philos 4354).

MATH 5215 Introduction To Real Analysis (LEC 3.0)
Riemann-Stieltjes integration, sequences and series of functions, uniform approximation, the Banach Space C(a,b), Lebesgue measure and integration, the space LP(a,b), Fourier series. Prerequisite: Math 4209.
Mathematics

MATH 5222 Vector And Tensor Analysis (LEC 3.0)
Vector algebra, vector differential and integral calculus, line and surface integrals, theorems of Stokes and Gauss, tensor algebra and tensor analysis, applications to problems in kinematics, elasticity theory, fluid mechanics, electromagnetic theory, relativity theory. Prerequisite: Math 2222; Math 3103 or Math 3108.

MATH 5302 Intermediate Differential Equations (LEC 3.0)
Linear differential equations, vector-matrix systems, existence and uniqueness theory, nonlinear systems, phase-plane analysis, introduction to stability theory. Prerequisite: Math 3304 or Math 3329.

MATH 5325 Partial Differential Equations (LEC 3.0)
Linear equations, heat equation, eigenfunction expansions, Green's formula, inhomogeneous problems, Fourier series, wave equation. Prerequisite: Math 3304 with a grade of "C" or better.

MATH 5351 Introduction To Complex Variables (LEC 3.0)
The basic tools of complex variables are studied. These include the Cauchy-Riemann equations, complex contour integration, the Cauchy-Goursat theorem, conformal mappings, the calculus of residues and applications to boundary value problems. Prerequisite: Math 3304.

MATH 5483 Operational Calculus (LEC 3.0)
The Laplace transformation, properties of the transformation, various applications to ordinary and partial differential equations, systems with step and Dirac functions as driving forces, various non-elementary functions and their transforms, problems in heat conduction and wave motion, Fourier transforms and their operational properties. Prerequisite: Math 3304.

MATH 5530 Topics in Geometry - Graduate Option (LEC 3.0)
A survey of non-Euclidean geometries, finite geometries, affine and projective planes, metric postulates for the Euclidean plane, and selected topics. Students will demonstrate graduate-level mastery of the subject matter. Credit will not be given for both Math 4530 and Math 5530. Prerequisites: MATH 3108.

MATH 5585 Introduction To Topology (LEC 1.0)
Metric spaces; general topological spaces; connectedness, compactness, separation properties, functions and continuity. Prerequisite: Math 4209.

MATH 5603 Methods of Applied Mathematics (LEC 3.0)
Methods to develop and analyze mathematical models. Topics include dimensional analysis and scaling, perturbation methods, and the construction of ordinary and partial differential equation models. Prerequisites: Math 3304 or 3329 with a grade of "C" or better, programming competency.

MATH 5604 Introduction to Numerical Methods for Differential Equations (LEC 3.0)
An introduction to finite difference methods for ordinary and partial differential equations, including (1) the derivation of the numerical methods, (2) implementation of the methods in Matlab, and (3) the mathematical accuracy and stability analysis of the methods. Prerequisites: MATH 3304 and programming competency (preferably Matlab).

MATH 5737 Financial Mathematics (LEC 3.0)
The course objective is to provide an understanding of the fundamental concepts of financial mathematics. Topics include pricing, assets-liability management, capital budgeting, valuing cash flow, bonds, futures, swaps, options. Preparation for the financial mathematics actuarial exam will be provided. Prerequisites: Math 1215 or Math 1221, Econ 2100 or Econ 2200 or Finance 2150 or Finance 5160, Stat 3111 or Stat 3113 or Stat 3115 or Stat 3117 or Stat 5643. (Co-listed with Econ 5337).

MATH 5940 Mathematical Analysis For Secondary Teachers (LEC 3.0)
Designed to help teachers gain a deeper understanding of the fundamental idea in analysis, that of a limit. A discovery method is used which includes both individual and group work. Students will present their results in written and oral format. Prerequisite: Math 2222 or equivalent.

MATH 5948 Mathematical Analysis For Secondary Teachers Practicum (LEC 1.0)
An instructional unit based on the discovery method used in Math 340 will be designed by each student. These units will be class tested. The unit and results of class testing will be presented both in written and oral format. Prerequisite: Math 5940.