



$$pw \text{ Cot } \left[\frac{m}{p} \right]$$

Case 2: $p > 2a$
 (p,q) torus knots
become
 (p,q) knotted graphs

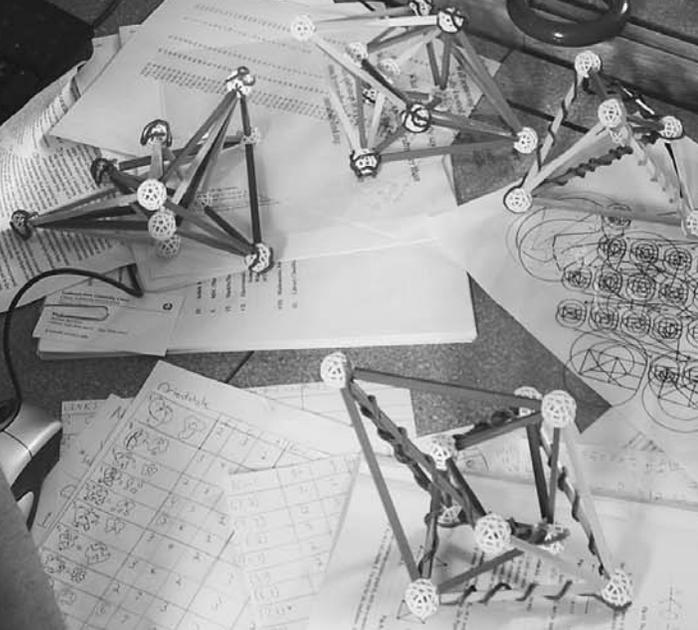


(7,2) torus knot

Increase the size
of the inside circle
until an under
crossing and an over
crossing make 180



[7,2] knotted graph



Program

BS in Mathematics

Options in:

Mathematics (General Option)

Applied Mathematics

Mathematics Education

Statistics

Minor in Mathematics

Minor in Statistics

Single Subject Teaching

Credential in Mathematics

The role of mathematics is vital and growing, providing solutions to problems in a wide range of sciences: social, biological, physical, behavioral, and management. As a tool, mathematics is necessary for understanding and expressing ideas in science, engineering and human affairs. Mathematics is integrally related to computer science and statistics, which have proven invaluable to advancing research and modern industrial technology. As a result, employment opportunities in the mathematical sciences are expected to continue to expand.

The Option in Applied Mathematics prepares students either to assume attractive and challenging positions in aerospace, electronics, or to pursue graduate work in pure or applied mathematics.

The Option in Statistics provides a program balanced between theoretical and applied statistics. Students are especially well prepared to pursue a graduate degree. Statisticians find many career opportunities in cutting-edge research in such fields as medicine, pharmaceuticals, business, quality control, and the social sciences.

The Single Subject Credential in Mathematics provides students with the necessary background for obtaining a California Secondary Teaching Credential in mathematics. A fifth year of education courses and student teaching is needed to complete the credential requirements.

Faculty and Facilities

The faculty have expertise in a wide variety of fields of mathematics plus a commitment to excellence in teaching. Individual members are involved in a number of exciting and creative efforts: computer applications of math, applications of math in business and economics, statistical research in biology and medicine, research in various areas of pure mathematics, and innovative approaches to teaching at the collegiate, secondary, and elementary levels. Students have the opportunity to participate in these challenging programs.

Many classes make use of graphing calculators and/or computers. The department maintains a well-equipped computer laboratory open to all mathematics students. In addition, the department has a tutorial laboratory where students can get help on course-related material.



Academic Activities

The department sponsors an active colloquium series which provides weekly talks on a variety of mathematical topics that are not traditionally included in the standard undergraduate curriculum. Past speakers have included some of the world's most famous mathematicians and scientists, faculty members from many foreign and U.S. universities, as well as undergraduate students.

The CSU, Chico Mathematics Club is open to any interested student. The organization sponsors lectures, field trips, and a variety of social activities. Mathematics majors are encouraged to become involved.

Career Outlook

Mathematicians today are involved in a variety of activities, ranging from the creation of new theories to the analysis of scientific and managerial models. Beginning jobs as mathematicians are likely to be competitive in the near future; both demand and supply are expected to increase. There is a need for more mathematicians to solve complex research and development problems in engineering, the natural and social sciences, military sciences, operations research, and business management.

Financial Support

In addition to university-wide scholarships, mathematics and statistics majors are eligible for several department and college awards and scholarships. To be considered for these scholarships, submit a university scholarship application to the Scholarship Office by the February deadline.

The Department of Mathematics hires 20-40 students each semester as readers or tutors. Students with good grades who have completed at least one upper-division mathematics course are encouraged to apply at the department office.



Mathematics

College of Natural Sciences
Dean: James IJ. Houpis

Department of Mathematics and Statistics

Holt Hall 181

530-898-6111

e-mail: math@csuchico.edu

http://www.csuchico.edu/math/

Chair: Terry Kiser

Undergraduate Advisers:

Consult the department office to be assigned an adviser.

THE BACHELOR OF SCIENCE IN MATHEMATICS

Total Course Requirements for the Bachelor's Degree: 120 units

See "Requirements for the Bachelor's Degree" in *The University Catalog* for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

A suggested Major Academic Plan (MAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

General Education Requirements: 48 units

See "General Education Requirements" in *The University Catalog* and *The Class Schedule* for the most current information on General Education Requirements and course offerings. The course requirements marked below with an asterisk (*) may also be applied toward General Education.

Cultural Diversity Course Requirements: 6 units

See "Cultural Diversity" in *The University Catalog*. Most courses taken to satisfy these requirements may also apply to General Education.

American Institutions Requirement: 6 units

See the "American Institutions Requirement" under "Bachelor's Degree Requirements." This requirement is normally fulfilled by completing HIST 130 and POLS 155. Courses used to satisfy this requirement do not apply to General Education.

Literacy Requirement:

See "Mathematics and Writing Requirements" in *The University Catalog*. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C- are required to repeat the course and earn a C- or better to receive WP credit. See *The Class Schedule* for the designated WP courses for each semester. You must pass ENGL 130 (or its equivalent) with a C- or better before you may register for a WP course.

Course Requirements for the Major: 48-49 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree. Additional required courses, depending upon the selected option or advising pattern, are outlined following the degree core program requirements.

DEGREE CORE PROGRAM: 24 units

6 courses required:

MATH 120	Analytic Geometry and Calculus	4.0	FS *
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.			
MATH 121	Analytic Geometry and Calculus	4.0	FS
Prerequisites: Completion of ELM requirement; MATH 120 with a grade of C- or higher.			
MATH 220	Analytic Geometry and Calculus	4.0	FS
Prerequisites: Completion of ELM requirement; MATH 121 with a grade of C- or higher.			
MATH 330	Methods of Proof	3.0	FS
Prerequisites: MATH 121.			
MATH 335	Elementary Linear Algebra	3.0	FS
Prerequisites: MATH 121.			
MATH 420	Advanced Calculus	3.0	FS WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, MATH 220, MATH 330, upper-division standing.			

The MATH 120, MATH 121, MATH 220 sequence should be started as early as possible, provided the student has the necessary background. MATH 118 and MATH 119 (or their equivalents) are required pre-calculus courses for MATH 120.

Some upper-division courses require only MATH 120 or MATH 121 as a prerequisite. Refer to catalog course listings when choosing courses.

Enrollment in any mathematics course requires a grade of C- or higher in all prerequisite courses or their transfer equivalents

Computer Literacy Requirement: Either a score of 4 or higher on the Educational Testing Service CSI 1 Examination, or a passing grade in one of the following classes or its transfer equivalent.

1 course selected from:

CSCI 110	Intro to Applications Prog	3.0	FS
Prerequisites: CSCI 111.			
CSCI 111	Programming and Algorithms I	3.0	FS
Prerequisites: At least one year of high school algebra and strong computer skills or CSCI 101.			
CSCI 144	Introduction to UNIX Operating	3.0	FS
MATH 150	Introduction to SAS	3.0	SP
Prerequisites: MATH 105, faculty permission.			
MATH 230	Introduction to Mathematica	3.0	FA
Prerequisites: MATH 121.			

Major Option Course Requirements: 24-25 units

The following courses, or their approved transfer equivalents, are required dependent upon the option chosen. *Students must select one of the following options* for completion of the major course requirements.

THE GENERAL OPTION IN MATHEMATICS: 25 units

2 courses required:

MATH 260	Elem Differential Equations	4.0	FS
Prerequisites: Completion of ELM requirement, MATH 121 with a grade of C- or better.			
MATH 350	Intro to Probability/Stat	3.0	FA
Prerequisites: MATH 121.			

1 course selected from:

MATH 346	College Geometry	3.0	SP
Prerequisites: MATH 220, MATH 330.			
MATH 426	Projective Geometry	3.0	Inq
Prerequisites: MATH 220, MATH 330.			
MATH 427	Convexity	3.0	Inq
Prerequisites: MATH 220, MATH 330.			
MATH 428	Differential Geometry	3.0	FA
Prerequisites: MATH 220, MATH 330.			
MATH 429	Transformational Geometry	3.0	Inq
Prerequisites: MATH 220, MATH 330.			
MATH 437	Topology	3.0	S2
Prerequisites: MATH 220, MATH 330.			

1 course selected from:

MATH 435	Linear Algebra	3.0	FA
Prerequisites: MATH 220, MATH 330, MATH 335.			
MATH 449	Modern Algebra	3.0	FS
Prerequisites: MATH 220, MATH 330, MATH 335.			

1 course selected from:

MATH 421	Advanced Calculus	3.0	SP
Prerequisites: MATH 420.			
MATH 465	Intro to Complex Variables	3.0	FA
Prerequisites: MATH 220.			

9 units selected from:

Any upper-division Mathematics (MATH) courses except MATH 305, MATH 314, MATH 310, MATH 311, MATH 341, MATH 342, MATH 441, MATH 302, MATH 304, MATH 315, and MATH 615.

THE OPTION IN APPLIED MATHEMATICS: 25 units

6 courses required:

MATH 260	Elem Differential Equations	4.0	FS
Prerequisites: Completion of ELM requirement, MATH 121 with a grade of C- or better.			
MATH 350	Intro to Probability/Stat	3.0	FA
Prerequisites: MATH 121.			
MATH 360	Ordinary Differen Equations	3.0	F1
Prerequisites: MATH 260.			
MATH 361	Boundary Value/Partial Dif Eqs	3.0	SP
Prerequisites: MATH 260.			
MATH 461	Numerical Analysis	3.0	S1
Prerequisites: MATH 260 (may be taken concurrently), MATH 335, completion of the computer literacy requirement. MATH 460 is not a prerequisite for MATH 461.			
MATH 465	Intro to Complex Variables	3.0	FA
Prerequisites: MATH 220.			

1 course selected from:

MATH 472	Intro Chaotic Dynamical Sys	3.0	S2
Prerequisites: MATH 260; MATH 360 and MATH 335 are recommended.			
MATH 475	Calculus of Variations	3.0	F1
Prerequisites: MATH 260; MATH 361 is recommended.			
MATH 480	Mathematical Modeling	3.0	S1
Prerequisites: MATH 260, MATH 335.			

1 course selected from:

MATH 351	Intro to Probability/Stat	3.0	SP
Prerequisites: MATH 350.			
MATH 421	Advanced Calculus	3.0	SP
Prerequisites: MATH 420.			
MATH 435	Linear Algebra	3.0	FA
Prerequisites: MATH 220, MATH 330, MATH 335.			
MATH 460	Numerical Analysis	3.0	S2
Prerequisites: MATH 220, MATH 335, completion of the computer literacy requirement.			
MATH 472	Intro Chaotic Dynamical Sys	3.0	S2
Prerequisites: MATH 260; MATH 360 and MATH 335 are recommended.			
MATH 475	Calculus of Variations	3.0	F1
Prerequisites: MATH 260; MATH 361 is recommended.			
MATH 480	Mathematical Modeling	3.0	S1
Prerequisites: MATH 260, MATH 335.			

THE OPTION IN MATHEMATICS EDUCATION: 24-25 units

The following program, together with the degree core program, fulfills all requirements for the Single Subject Matter Preparation Program in Mathematics.

7 courses required:

MATH 305	Conceptual Statistics	3.0	FS
Prerequisites: MATH 120 or MATH 109 (may be taken concurrently).			
MATH 333	History of Mathematics	3.0	SP
Prerequisites: MATH 220 and at least one upper-division mathematics course. MATH 330 is recommended.			
MATH 337	Intro to Theory of Numbers	3.0	FA
Prerequisites: MATH 121, MATH 330.			
MATH 341	Math Topics for the Credential	3.0	FA
Prerequisites: MATH 121.			
MATH 344	Combinatorial Math/Graph Theor	3.0	FA
Prerequisites: MATH 121, MATH 330.			
MATH 346	College Geometry	3.0	SP
Prerequisites: MATH 220, MATH 330.			
MATH 449	Modern Algebra	3.0	FS
Prerequisites: MATH 220, MATH 330, MATH 335.			

1 course selected from:

MATH 260	Elem Differential Equations	4.0	FS
Prerequisites: Completion of ELM requirement, MATH 121 with a grade of C- or better.			

Or any upper-division Mathematics (MATH) courses except MATH 310, MATH 311, MATH 302, MATH 304, MATH 315, and MATH 615.

Additional requirements:

A portfolio of upper-division mathematics work is required and will be evaluated by a department committee as part of an exit interview. A 15-hour mathematics field experience is required. A presentation on mathematics is required. This requirement can be met by successful completion of MATH 342 or by making a presentation to the Math Club. All course work choices, work on the portfolio, and the choice of field experience should be made after consulting an adviser.

THE OPTION IN STATISTICS: 24 units

6 courses required:

MATH 350	Intro to Probability/Stat	3.0	FA
Prerequisites: MATH 121.			
MATH 351	Intro to Probability/Stat	3.0	SP
Prerequisites: MATH 350.			
MATH 355	Applied Probability	3.0	S1
Prerequisites: MATH 220, MATH 350.			
MATH 356	Experimental Design	3.0	FA
Prerequisites: MATH 105 or MATH 350 or MATH 315.			
MATH 435	Linear Algebra	3.0	FA
Prerequisites: MATH 220, MATH 330, MATH 335.			
MATH 450	Mathematical Statistics	3.0	FA
Prerequisites: MATH 220, MATH 330, MATH 351.			

1 course selected from:

MATH 456	Experimental Design II	3.0	S2
Prerequisites: MATH 356.			
MATH 457	Multiple Regression	3.0	S2
Prerequisites: MATH 350 (or MATH 105 with faculty permission), MATH 335, MATH 150 (may be taken concurrently).			
MATH 458	Sampling Methods	3.0	S2
Prerequisites: One course chosen from MATH 105, MATH 305, MATH 350, or MATH 315.			

3 units selected from:

Any upper-division mathematics (MATH) courses except MATH 302, MATH 304, MATH 310, MATH 311, MATH 314, MATH 315, MATH 341, MATH 342, and MATH 441.

Electives Requirement:

To complete the total units required for the bachelor's degree, select additional elective courses from the total university offerings. You should consult with an adviser regarding the selection of courses which will provide breadth to your university experience and possibly apply to a supportive second major or minor.

Enrollment in any mathematics course requires a grade of C- or higher in all prerequisite courses or their transfer equivalents.

Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade except those courses specified by the department as Credit/No Credit grading only.

Advising Requirement:

Advising is mandatory for all majors in this degree program. Consult your undergraduate adviser for specific information.

A student may complete more than one option in the major. Only courses specifically required by both options may be double counted.

Honors in the Major

Honors in the Major is a program of independent work in your major. It involves 6 units of honors course work completed over two semesters.

Your Honors work will be recognized at your graduation, on your permanent transcripts, and on your diploma. It is often accompanied by letters of commendation from your mentor in the department or the department chair. Most importantly, however, the Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original performance or research project. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the university for submission in professional journals, presentation at conferences, or competition in shows; such experience is valuable for graduate school and later professional life.

Some common features of Honors in the Major program are

1. You must take 6 units of Honors in the Major course work. At least 3 of these 6 units are independent study (499H) as specified by your department. You must complete each class with a minimum grade of B.
2. You must have completed 9 units of upper-division course work or 21 overall units in your major before you can be admitted to Honors in the Major. Check the requirements carefully, as there may be specific courses that must be included in these units.
3. Your *cumulative* GPA should be at least 3.5 or within the top 5 percent of majors in your department.
4. Your GPA *in your major* should be at least 3.5 or within the top 5 percent of majors in your department.
5. Most students apply for or are invited to participate in Honors in the Major during the second semester of their junior year. Then they complete the 6 units of course work over the two semesters of their senior year.
6. Your honors work culminates with a public presentation of your Honors project.

While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your major department or major adviser for further information.

Honors in Mathematics

Well-qualified Mathematics majors are encouraged to apply for Honors in Mathematics. The program is open to junior and senior Mathematics majors who have completed 9 upper-division units (or a total of 24 units) in mathematics, including MATH 420 with a grade of B or better, and have a grade point average among the top 5% of junior-senior mathematics majors. Please visit the department office in HOLT 181 for further information.

Mathematics

THE MINOR IN MATHEMATICS

Course Requirements for the Minor: 25 units

The following courses, or their approved transfer equivalents, are required of all candidates for this minor.

4 courses required:

MATH 120	Analytic Geometry and Calculus	4.0	FS *
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.			
MATH 121	Analytic Geometry and Calculus	4.0	FS
Prerequisites: Completion of ELM requirement; MATH 120 with a grade of C- or higher.			
MATH 220	Analytic Geometry and Calculus	4.0	FS
Prerequisites: Completion of ELM requirement; MATH 121 with a grade of C- or higher.			
MATH 260	Elem Differential Equations	4.0	FS
Prerequisites: Completion of ELM requirement, MATH 121 with a grade of C- or better.			

9 units selected from:

Upper-division courses, at least 6 of which must be from the Department of Mathematics and Statistics. Three units may be from another department as long as the course has significant mathematical content, as determined by the chair of the Department of Mathematics and Statistics. Acceptable upper-division MATH units will not include MATH 302, MATH 305, MATH 310, MATH 311, MATH 315, MATH 333, MATH 341, MATH 342, MATH 355, MATH 441, MATH 615.

TO APPLY FOR A MINOR

To apply for a minor, you must file a Declaration of Minor form, available in the Department Office, HOLT 181. Before choosing any options for the minor, you must obtain approval from the department chair.

THE MINOR IN STATISTICS

Course Requirements for the Minor: 20 units

The following courses, or their approved transfer equivalents, are required of all candidates for this minor.

6 courses required:

MATH 120	Analytic Geometry and Calculus	4.0	FS *
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.			
MATH 121	Analytic Geometry and Calculus	4.0	FS
Prerequisites: Completion of ELM requirement; MATH 120 with a grade of C- or higher.			
MATH 335	Elementary Linear Algebra	3.0	FS
Prerequisites: MATH 121.			
MATH 350	Intro to Probability/Stat	3.0	FA
Prerequisites: MATH 121.			
MATH 351	Intro to Probability/Stat	3.0	SP
Prerequisites: MATH 350.			
MATH 356	Experimental Design	3.0	FA
Prerequisites: MATH 105 or MATH 350 or MATH 315.			

TO APPLY FOR A MINOR

To apply for a minor, you must file a Declaration of Minor form, available in the Department Office, HOLT 181. Before choosing any options for the minor, you must obtain approval from the department chair.

THE SINGLE SUBJECT TEACHING CREDENTIAL IN MATHEMATICS

Course Requirements for the Single Subject Teaching Credential: 48-49 units

In most majors, candidates for this credential will normally fulfill the single subject matter preparation program by completing the appropriate education option in the major. Any exceptions to this procedure are noted at the end of this section. In addition to the single subject matter preparation program, completion of an additional professional education program is required to qualify for a California teaching credential. Professional education (credential) programs are available through the School of Education. For prerequisites and other admission requirements to professional education programs, see the "Education" chapter of this catalog.

Your departmental credential adviser is responsible for verifying that the subject matter preparation program has been completed. If you are interested in obtaining a teaching credential, confer with the appropriate credential adviser early in your university career. Department credential advisers can assist you in planning an educational program that meets both major and credential requirements.

Subject matter preparation requirements are governed by federal and state legislative action and approval of the California Commission on Teacher Credentialing. Requirements may change between catalogs. Please consult with your departmental credential adviser for current information.

The Option in Mathematics Education together with the core program, both described previously, fulfill all requirements for the Single Subject Matter Preparation Program in Mathematics.

SUPPLEMENTARY AUTHORIZATION IN MATHEMATICS

A supplementary authorization to teach introductory mathematics can be added to a valid California Single or Multiple Subject Credential by taking 20 units (or 10 upper-division units) of non-remedial mathematics courses. Please consult with a departmental credential adviser for recommended courses.

The Faculty

Jorgen J. Berglund, 2002, Assist Professor, PhD, U Mass.
Nancy J. Carter, 1982, Professor, PhD, Oregon State U.
Rapti M. deSilva, 2001, Assist Professor, PhD, Syracuse U.
William B. Fisher, 1974, Professor, PhD, U Oregon.
Sergei Fomin, 2004, Assist Professor, PhD, RUS: Kazan State Univ.
Richard L. Ford, 1990, Professor, PhD, UC Irvine.
Colin M. Gallagher, 2002, Assist Professor, PhD, UCSB.
Eliza D. Gallagher, 1998, Assoc Professor, PhD, NC State U.
Simon M. Goberstein, 1981, Professor, PhD, Univ of Arkansas, Fayetteville.
LaDawn Haws, 1988, Professor, PhD, UC Davis.
Terry L. Kiser, 1988, Chair, Professor, PhD, Oregon State U.
John A. Ladwig, 1982, Professor, PhD, U Oregon.
Thomas Mattman, 2000, Assist Professor, PhD, McGill U.
Mervin E. Meyer, 1982, Professor, PhD, UCR.
Margaret A. Owens, 1984, Associate Dean, Professor, PhD, U Oregon.
Vladimir Rosenhaus, 1999, Assoc Professor, PhD, USSR Academy of Sciences.
Robin N. Soloway, 1972, Professor, PhD, U WI.
Emeritus Faculty
Frank E. Burk, 1968, Professor Emeritus, PhD, UCR.
Dennis I. Goslin, 1965, Professor Emeritus, MS, Oregon State U.
Gordon H. Hughes, 1974, Professor Emeritus, PhD, UCR.
Eric S. Langford, 1981, Professor Emeritus, PhD, Rutgers U.
Edward M. Matzdorff, 1970, Professor Emeritus, PhD, Oregon State U.
Thomas A. McCready, 1968, Professor Emeritus, PhD, Stanford U.
Sharon R. Ross, 1987, Professor Emerita, PhD, UC Berkeley.
Neil C. Schwertman, 1974, Professor Emeritus, PhD, U Kentucky.

Mathematics Course Offerings

Please see the section on "Course Description Symbols and Terms" in *The University Catalog* for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

In certain courses, at the discretion of the instructor, you may be required to buy a computer program and/or graphing calculator.

Completion of the Entry-Level Mathematics (ELM) requirement is a prerequisite for registration in all MATH courses.

MATH 011 Intensive Beginning Algebra 5.0 Fa/Spr

Prerequisites: ELM score of 32 or lower.

This non-baccalaureate course employs non-traditional teaching methods and learning strategies that have been specially designed to enhance student success in the course. Introduction to the basic properties of real numbers, variables, equations, algebraic expressions, functions and their graphs. Includes evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; solving two linear equations in two unknowns; real world applications. Satisfactory completion of this course fulfills the prerequisite for enrollment in Intermediate Algebra (MATH 012 or MATH 051). ABC/no credit grading only. This course is designated remedial and does not count as credit toward the bachelor's degree, although the units may be applied to financial aid minimum requirements. Formerly MATH 001A.

- MATH 012 Intensive Intermediate Algebra** 5.0 Fa/Spr
Prerequisites: Credit in MATH 011, faculty permission.
This non-baccalaureate course employs non-traditional teaching methods and learning strategies that have been specially designed to enhance student success in the course. Review of linear equations, inequalities, exponents, and polynomials, functions, rational expressions, rational exponents, and radicals, quadratic equations, systems of linear equations and logarithms. Satisfactory completion of this course fulfills the prerequisite for enrollment in a General Education level mathematics course. ABC/no credit grading only. This course is designated remedial and does not count as credit toward the bachelor's degree, although the units may be applied to financial aid minimum requirements. Formerly MATH 001B.
- MATH 031 Beginning Algebra** 5.0 Fa/Spr
Prerequisites: ELM score of 34-40.
Introduction to the basic properties of real numbers, variables, equations, algebraic expressions, functions and their graphs. This includes evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; solving two linear equations in two unknowns; real world applications. During the fourth week of class, an MDTP exam will be given. Students who pass will automatically be transferred to MATH 032, which meets at the same time; students who do not pass will remain enrolled in MATH 031. Satisfactory completion of this course fulfills the prerequisite for enrollment in Intermediate Algebra. ABC/no credit grading only. This course is designated remedial and does not count as credit toward the bachelor's degree, although the units may be applied to financial aid minimum requirements. Formerly MATH 002A.
- MATH 032 Accelerated Intermediate Algebra** 5.0 Fa/Spr
Prerequisites: Successful completion of MDTP exam given in MATH 031.
This course is open only to students enrolled in MATH 031 (or in MATH 011 with instructor permission) who pass an MDTP exam during the fourth week of classes. If a student passes the exam, his or her enrollment will automatically be changed to MATH 032. The content of this course is identical with that of MATH 051. Satisfactory completion of this course fulfills the prerequisite for enrollment in a General Education level mathematics course and satisfies the ELM requirement. ABC/no credit grading only. This course is designated remedial and does not count as credit toward the bachelor's degree, although the units may be applied to financial aid minimum requirements. Formerly MATH 002B.
- MATH 051 Intermediate Algebra** 3.0 Fa/Spr
Prerequisites: Credit in MATH 011 or credit in MATH 031; or ELM score 42-48.
Review of linear equations, inequalities, exponents, and polynomials. Functions, rational expressions, rational exponents, and radicals, quadratic equations, systems of linear equations, and logarithms. Satisfactory completion of this course fulfills the prerequisite for enrollment in a General Education level mathematics course and satisfies the ELM requirement. ABC/no credit grading only. This course is designated remedial and does not count as credit toward the bachelor's degree, although the units may be applied to financial aid minimum requirements. Formerly MATH 003.
- MATH 101 Patterns of Mathematical Thought** 3.0 Fa/Spr
Prerequisites: Completion of ELM requirement.
An informal approach to mathematics designed to bring an appreciation and workable knowledge of the subject to non-majors. Not acceptable for a mathematics major or minor. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 010. CAN MATH 2.
- MATH 101H Patterns of Mathematical Thought — Honors** 3.0 Fall
Prerequisites: Completion of ELM requirement, acceptance into the Honors in General Education Program.
A special section of MATH 101 for students in the Honors in General Education program. An informal approach to mathematics designed to bring an appreciation and workable knowledge of the subject to non-majors. Not acceptable for a mathematics major or minor. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 010H.
- MATH 105 Statistics** 3.0 Fa/Spr
Prerequisites: Completion of ELM requirement.
Summary of numerical data, elementary probability, distributions, and introduction to statistical inference. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 005. CAN STAT 2.
- MATH 105H Statistics - Honors** 3.0 Fall
Prerequisites: Completion of ELM requirement, acceptance into the Honors in General Education Program.
A special section of MATH 105 for students in the Honors in General Education Program. Summary of numerical data, elementary probability, distributions, and introduction to statistical inference. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 005H.
- MATH 107 Finite Mathematics for Business** 3.0 Fa/Spr
Prerequisites: Completion of ELM requirement.
Solutions to systems of linear equations, matrices, linear programming, combinatorics, probability, binomial and normal distributions. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 045. CAN MATH12.
- MATH 108 Statistics of Business and Economics** 3.0 Fa/Spr
Prerequisites: For business administration students: MATH 107. For other students: completion of General Education Breadth Area A4 requirement.
Descriptive statistics, sampling theory, statistical inference and tests of hypotheses, analysis of variance, chi-square tests, simple regression and correlation, and multiple regression and correlation. Formerly MATH 047.
- MATH 109 Survey of Calculus** 3.0 Fa/Spr
Prerequisites: Completion of ELM requirement. This course is not intended for majors in mathematics, physics, chemistry, or engineering.
This course covers limits, continuity, and differentiation. Polynomial, rational, trigonometric, exponential, and logarithmic functions are included. Applications are chosen from a variety of fields. No credit for students with credit in MATH 120. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 009. CAN MATH30.
- MATH 110 Concepts and Structures of Mathematics** 3.0 Fa/Spr
Prerequisites: Completion of ELM requirement.
Structure of the real number system, operations on real numbers, number theory. Not acceptable for a mathematics major or minor. Formerly MATH 050A.
- MATH 111 Concepts and Structures of Mathematics** 3.0 Fa/Spr
Prerequisites: Completion of ELM requirement, one year of high school geometry.
Problem-solving, probability and statistics, measurement and the metric system, geometry. Not acceptable for a mathematics major or minor. Formerly MATH 050B.
- MATH 115 MathLinks Seminar, Primary** 1.0 Fa/Spr
Prerequisites: MATH 110, concurrent enrollment in MATH 111, faculty permission.
Number sense, algebra and functions, data analysis, probability, statistics, geometry, measurement, and mathematical reasoning in primary grades classrooms. Weekly tutoring in mathematics in primary grades classrooms is a course requirement. Not acceptable for mathematics major or minor. 2.0 hours activity. Credit/no credit grading only. Formerly MATH 051A.
- MATH 116 MathLinks Seminar, Intermediate** 1.0 Fa/Spr
Prerequisites: MATH 110, concurrent enrollment in MATH 111, faculty permission
Number sense, algebra and functions, data analysis, probability, statistics, geometry, measurement, and mathematical reasoning in intermediate grades classrooms. Weekly tutoring in mathematics in intermediate grades classrooms is a course requirement. Not acceptable for a mathematics major or minor. 2.0 hours activity. Credit/no credit grading only. Formerly MATH 051B.
- MATH 118 Trigonometry** 3.0 Fa/Spr
Prerequisites: Completion of ELM requirement.
Trigonometric functions, graphs, identities and conditional equations, logarithms, solutions of triangles, and complex numbers. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 004. CAN MATH 8.
- MATH 119 Precalculus Mathematics** 4.0 Fa/Spr
Prerequisites: Completion of ELM requirement, and either 1/2 year of high school trigonometry or MATH 118.
Functions and graphs, including polynomial, rational, exponential, logarithmic, and trigonometric functions. Systems of equations and inequalities, polar and parametric equations, complex numbers, and analytic trigonometry. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 006. CAN MATH16.
- MATH 119X Precalculus Problem Session** 1.0 Fa/Spr
Prerequisites: Concurrent enrollment in MATH 119, faculty permission.
Designed to supplement MATH 119 with additional applications. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. Formerly MATH 006X.
- MATH 120 Analytic Geometry and Calculus** 4.0 Fa/Spr
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.
Limits and continuity. The derivative and applications to related rates, maxima and minima, and curve sketching. Transcendental functions. An introduction to the definite integral and area. A grade of C- or higher is required for GE credit. This is an approved General Education course. Formerly MATH 007A. CAN MATH18.

Mathematics

- MATH 120X Calculus Problem Session** 1.0 Fa/Spr
Prerequisites: Completion of ELM requirement, concurrent enrollment in MATH 120, faculty permission.
Designed to supplement MATH 120 with additional applications of introductory calculus. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. Formerly MATH 007X.
- MATH 121 Analytic Geometry and Calculus** 4.0 Fa/Spr
Prerequisites: Completion of ELM requirement; MATH 120 with a grade of C- or higher.
The definite integral and applications to area, volume, work, differential equations, etc. Sequences and series, vectors and analytic geometry in 2 and 3-space, polar coordinates, and parametric equations. Formerly MATH 007B. CAN MATH20.
- MATH 121X Calculus Problem Session** 1.0 Fa/Spr
Prerequisites: Completion of ELM requirement, concurrent enrollment in MATH 121, faculty permission.
Designed to supplement MATH 121 with additional applications and expanded explanations of concepts encountered in second-semester calculus. Provides the student with the opportunity for additional assistance in coming to an understanding of the concepts of calculus. 2.0 hours activity. Credit/no credit grading only. Formerly MATH 007Y.
- MATH 150 Introduction to SAS** 3.0 Spring
Prerequisites: MATH 105, faculty permission.
An introduction to the basic SAS software, IML (interactive matrix language), data management, some SAS statistical procedures (PROCS) and graphing software. This course emphasizes learning the SAS system through projects and computer lab exercises involving data collection and computer simulation. This course satisfies the computer literacy requirement for mathematics majors. Formerly MATH 095.
- MATH 198 Special Topics** 1.0-4.0 Fa/Spr
Prerequisites: Completion of ELM requirement.
This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See *The Class Schedule* for the specific topic being offered. Formerly MATH 098.
- MATH 220 Analytic Geometry and Calculus** 4.0 Fa/Spr
Prerequisites: Completion of ELM requirement; MATH 121 with a grade of C- or higher.
Vector functions and space curves. Functions of several variables, partial derivatives, and multiple integrals. Vector calculus — line integrals, surface integrals, divergence/curl, Green's Theorem, Divergence Theorem, and Stokes' Theorem. Formerly MATH 007C. CAN MATH22.
- MATH 230 An Introduction to Computer Algebra Systems - Mathematics** 3.0 Fall
Prerequisites: MATH 121.
An introduction to Mathematica — a high-level mathematical programming environment with built-in symbolic, graphical, and numerical capabilities — emphasizing problem solving and functional programming. This course satisfies the computer literacy requirement for mathematics majors. Formerly MATH 065.
- MATH 260 Elementary Differential Equations** 4.0 Fa/Spr
Prerequisites: Completion of ELM requirement, MATH 121 with a grade of C- or better.
First order separable, linear, and exact equations; second order linear equations, Laplace transforms, series solutions at an ordinary point, systems of first order linear equations, and applications. Formerly MATH 007D. CAN MATH24.
- MATH 302 Science and Strategy in War and Peace** 3.0 Spring
Prerequisites: Completion of the General Education Breadth Area A4 requirement, Mathematical Concepts.
An introduction to quantitative methods used to wage, analyze, and prevent war, including game theory, linear programming, probability, fuzzy set theory, and computer simulations. This course cannot be used for credit toward a mathematics major or minor, a mathematics emphasis under the Liberal Studies major, or any credential. This is an approved General Education course. Formerly MATH 152.
- MATH 304 Statistical Tests for Inequalities** 3.0 Fa/Spr
Prerequisites: Completion of General Education Breadth Area A4 requirement.
The study of statistical principles. Descriptive statistics, regression analysis, sampling theory, statistical inference for population means and proportions. Economic systems. Ideologies related to economic systems. Quantitative and statistical measures of economic inequality, including the Gini index, Lorenz curve, Income Disparity Index, and the Kuznets curve. Applications to social and economic inequality. This course may not be used to fulfill requirements for a major or minor in mathematics. This is an approved General Education course. Formerly MATH 155.
- MATH 305 Conceptual and Practical Statistics** 3.0 Fa/Spr
Prerequisites: MATH 120 or MATH 109 (may be taken concurrently).
Design of statistical experiments, graphing, sampling techniques, probability, and common probability distributions will be discussed, with an emphasis on practical applications. Uses and misuses of statistics, misrepresentation of data, and proper and improper statistical analyses will be discussed. Formerly MATH 103.
- MATH 310 Patterns and Structures in Mathematics** 3.0 Fa/Spr
Prerequisites: MATH 110, MATH 111.
An intuitive investigation into mathematics to find recurrent themes. Problem-solving techniques and a search for patterns will be used throughout a discussion of topics such as modular arithmetic, complex numbers, mathematical sequences and their applications. Not acceptable for a mathematics major or minor. Special fee required; see *The Class Schedule*. Formerly MATH 112.
- MATH 311 Intuitive Foundations of Geometry** 3.0 Fa/Spr
Prerequisites: MATH 110, MATH 111.
An intuitive approach to problem-solving in coordinate geometry, motion geometry, and space geometry. Concrete models will be used for analyzing abstract ideas. Not acceptable for a mathematics major or minor. Formerly MATH 113.
- MATH 314 Probability and Statistics for Science and Technology** 4.0 Fa/Spr
Prerequisites: MATH 121.
Basic concepts of probability and statistics with emphasis on models used in science and technology. Probability models for statistical estimation and hypothesis testing. Confidence limits. One- and two-sample inference, simple regression, one- and two-way analysis of variance. Credit cannot be received for both MATH 350 and MATH 314. Formerly MATH 104.
- MATH 315 Biometrics** 3.0 Fall
Prerequisites: Completion of ELM requirement.
Interpretation of biomedical data, elementary probability and its application to the biological sciences, and statistical inference in the biomedical fields. This course may not be counted toward either a mathematics major or upper-division units of a minor. Intended for students in the biological sciences and health-related fields. Formerly MATH 215.
- MATH 317 Discrete Mathematical Structures** 3.0 Fa/Spr
Prerequisites: MATH 120.
A formal introduction to discrete structures which are relevant to mathematics and computer science. Structures studied include sets, cosets, graphs, trees, groups, vector spaces, fields, lattices, and Boolean algebras. Properties of these structures will be developed using methods such as logical deduction, induction, recursion, and combinatorial computing. Applications include program structures, data structures, network optimization, decision trees, tree searches, binary codes, automata, and the algebra of switching. Formerly MATH 120.
- MATH 330 Methods of Proof** 3.0 Fa/Spr
Prerequisites: MATH 121.
A survey of elementary principles of logic, emphasizing the nature of proof. Standard methods of proof will be illustrated with examples from various branches of mathematics, including set theory and the theory of functions and relations. Other possible sources of examples include the calculus, number theory, theory of equations, topology of the real line. Formerly MATH 100.
- MATH 333 History of Mathematics** 3.0 Spring
Prerequisites: MATH 220 and at least one upper-division mathematics course. MATH 330 is recommended.
Study of the historical development of mathematics, with particular emphasis on the relationship between mathematics and society. Formerly MATH 102.
- MATH 335 Elementary Linear Algebra** 3.0 Fa/Spr
Prerequisites: MATH 121.
Matrices, determinants, cartesian n-space (basis and dimension of a subspace, rank, change of basis), linear transformations, eigenvalues. Numerical problems will be emphasized. Formerly MATH 135.
- MATH 337 Introduction to the Theory of Numbers** 3.0 Fall
Prerequisites: MATH 121, MATH 330.
Basic properties of the integers, division algorithm, fundamental theorem of arithmetic, number-theoretic functions, Diophantine equations, congruences, quadratic residues, continued fractions. Formerly MATH 250.

- MATH 341 Mathematical Topics for the Credential** 3.0 Fall
Prerequisites: MATH 121.
This course is designed to supplement the mathematical background of the candidate for the single subject credential in mathematics. The mathematical topics will be discussed from the student's and the teacher's points of view to aid the candidate in making the transition to secondary school mathematics. Topics include mathematical problem-solving, conceptual ideas using algebra, geometry, and functions, incorporating technology into the mathematics curriculum, and finite systems. Special fee required; see *The Class Schedule*. Formerly MATH 114A.
- MATH 342 Math Topics for the Credential** 3.0 Spring
Prerequisites: MATH 341.
This course focuses on having students examine mathematical pedagogy and the understanding and evaluations of students as mathematical learners as it analyzes secondary mathematics curriculum from an advanced standpoint. Students will have opportunities to be involved in the facilitation of mathematical learning. Topics include: history of mathematics education, contemporary mathematics curricula, problem solving, mathematical reasoning and methods of proof, mathematical learning theories, communication, assessment and collaborative learning communities. Formerly MATH 114B.
- MATH 344 Combinatorial Mathematics and Graph Theory** 3.0 Fall
Prerequisites: MATH 121, MATH 330.
The analysis of mathematical and applied problems through the use of permutations and combinations, generating functions and recurrence relations. Directed graphs, trees, connectivity, and duality. Formerly MATH 266.
- MATH 346 College Geometry** 3.0 Spring
Prerequisites: MATH 220, MATH 330.
An exploration of axioms and models for Euclidean and non-Euclidean geometries focusing on the independence of the Parallel Postulate. Additional topics will be chosen from Euclidean plane geometry, transformation geometry, and the geometry of polyhedra. Formerly MATH 201.
- MATH 350 Introduction to Probability and Statistics** 3.0 Fall
Prerequisites: MATH 121.
Basic concepts of probability theory, random variables and their distributions, limit theorems, sampling theory, topics in statistical inference, regression, and correlation. Formerly MATH 105A.
- MATH 351 Introduction to Probability and Statistics** 3.0 Spring
Prerequisites: MATH 350.
Continuation of MATH 350. Formerly MATH 105B.
- MATH 355 Applied Probability** 3.0 OddSp
Prerequisites: MATH 220, MATH 350.
Markov chains, birth and death processes, steady-state queuing theory, more general Markov processes, Chapman-Kolmogorov equations, simulation (Monte-Carlo), stochastic networks (PERT), applications to reliability, replacement, and inventory control. Formerly MATH 255.
- MATH 356 Experimental Design I** 3.0 Fall
Prerequisites: MATH 105 or MATH 350 or MATH 315.
The analysis of variance applied to fixed, random, and mixed models. Use of linear statistical models and regression in data analysis. Appropriate for mathematics and computer science majors and for graduate students in the biological, health, and agricultural sciences. Formerly MATH 216.
- MATH 360 Ordinary Differential Equations** 3.0 OddFa
Prerequisites: MATH 260.
Systems of first order linear equations, existence and uniqueness theorems, stability, Sturm separation theorems, power series methods. Formerly MATH 109.
- MATH 361 Boundary Value Problems and Partial Differential Equations** 3.0 Spring
Prerequisites: MATH 260.
Partial differential equations, separation of variables, orthogonal sets of functions, Sturm-Liouville problems, Fourier series, boundary value problems for the wave equation, heat equation, and Laplace equation; Bessel functions, Legendre polynomials. Formerly MATH 110.
- MATH 398 Special Topics in Mathematics** 1.0-3.0 Fa/Spr
Prerequisites: At least one 100- or 200-level mathematics course appropriate to the subject, faculty permission.
This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See *The Class Schedule* for the specific topic being offered. Formerly MATH 198.
- MATH 399 Special Problems** 1.0-3.0 Fa/Spr
This course is an independent study of special problems offered for 1.0-3.0 units. You must register directly with a supervising faculty member. MATH 399 cannot be used to fulfill major requirements without prior approval of the adviser and department chair. You may take this course more than once for a maximum of 6.0 units. Credit/no credit grading only. Formerly MATH 199.
- MATH 420 Advanced Calculus** 3.0 Fa/Spr
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, MATH 220, MATH 330, upper-division standing.
Limits, continuity, uniform continuity, the definite integral, series, convergence, uniform convergence, and metric spaces. Differentiation and integration of functions of several variables. Transformation of multiple integrals. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors. Formerly MATH 228A.
- MATH 421 Advanced Calculus** 3.0 Spring
Prerequisites: MATH 420.
Continuation of MATH 420. Formerly MATH 228B.
- MATH 426 Projective Geometry** 3.0 Inquire
Prerequisites: MATH 220, MATH 330.
Axiomatic geometry of the projective plane. Duality, collineations, correlations, polarities, and conics. Formerly MATH 214B.
- MATH 427 Convexity** 3.0 Inquire
Prerequisites: MATH 220, MATH 330.
The isoperimetric problem and other extremum problems. Sets of constant width. Linear programming. Formerly MATH 214C.
- MATH 428 Differential Geometry** 3.0 Fall
Prerequisites: MATH 220, MATH 330.
The geometry of curves and surfaces in Euclidean 3-space. Formerly MATH 214D.
- MATH 429 Transformational Geometry** 3.0 Inquire
Prerequisites: MATH 220, MATH 330.
Similarity groups, affine groups, projective groups and their invariants. Formerly MATH 214E.
- MATH 435 Linear Algebra** 3.0 Fall
Prerequisites: MATH 220, MATH 330, MATH 335.
Vector spaces, linear operators, bilinear forms and scalar products, unitary spaces; matrix polynomials, eigenvalues, and Jordan normal form. Formerly MATH 235.
- MATH 437 Topology** 3.0 EvenSp
Prerequisites: MATH 220, MATH 330.
Metric spaces, continuous functions, homeomorphisms, separation, and covering axioms, connectedness. Formerly MATH 270.
- MATH 441 Math Topics for the Credential** 4.0 Fa/Spr
Prerequisites: MATH 342.
Corequisites: Assignment as a Mathematics Department intern.
Supervised internship in teaching mathematics with accompanying seminar. Guidance in facilitation of mathematical learning. Topics include contemporary mathematics curriculum topics, mathematical learning theories, communication, and assessment. 3.0 hours seminar, 3.0 hours supervision. You may take this course more than once for a maximum of 8.0 units. Credit/no credit grading only. Formerly MATH 114C.
- MATH 449 Modern Algebra** 3.0 Fa/Spr
Prerequisites: MATH 220, MATH 330, MATH 335.
Introduction to basic algebraic structures such as groups, ring, and fields. The fundamental concepts of homomorphism, subgroup, normal subgroup and factor group of a group as well as subring, ideal and factor ring of a ring; permutation groups and matrix groups. Formerly MATH 237.
- MATH 450 Mathematical Statistics** 3.0 Fall
Prerequisites: MATH 220, MATH 330, MATH 351.
A rigorous theoretical treatment of the following topics: transformations of random variables, estimation, Neyman-Pearson hypothesis testing, likelihood ratio tests, and Bayesian statistics. Formerly MATH 205.
- MATH 456 Experimental Design II** 3.0 EvenSp
Prerequisites: MATH 356.
Advanced topics such as blocking, Latin squares, confounding, multiple regression, and the analysis of covariance. The general linear model. No credit for mathematics majors, except for the Option in Statistics. Formerly MATH 225A.
- MATH 457 Multiple Regression** 3.0 EvenSp
Prerequisites: MATH 350 (or MATH 105 with faculty permission), MATH 335, MATH 150 (may be taken concurrently).
The theory and application of multiple regression methods with simple linear regression as a special case. Appropriate for mathematics, computer science, engineering, psychology, social science, agriculture, biology, and other majors. Formerly MATH 225B.
- MATH 458 Sampling Methods** 3.0 EvenSp
Prerequisites: One course chosen from MATH 105, MATH 305, MATH 350, or MATH 315.
The theory and application of survey sampling techniques. Topics include simple random sampling, stratified sampling, systematic sampling, and cluster sampling. Appropriate for mathematics, computer science, psychology, social science, agriculture, biology, and other majors. Formerly MATH 225C.

Mathematics

MATH 460 Numerical Analysis 3.0 EvenSp

Prerequisites: MATH 220, MATH 335, completion of the computer literacy requirement.

Error analysis; numerical solution of algebraic and transcendental equations; systems of linear and non-linear equations; matrix inversion; interpolation and extrapolation. Formerly MATH 241A.

MATH 461 Numerical Analysis 3.0 OddSp

Prerequisites: MATH 260 (may be taken concurrently), MATH 335, completion of the computer literacy requirement. MATH 460 is not a prerequisite for MATH 461.

Approximation; numerical integration; numerical solution of ordinary and partial differential equations; matrix eigenvalues and eigenvectors. Formerly MATH 241B.

MATH 465 Introduction to Complex Variables 3.0 Fall

Prerequisites: MATH 220.

Algebra of Complex Numbers, Cauchy-Riemann Equations, the exponential, trigonometric, and logarithmic functions, complex integration and Cauchy integral formula, Taylor and Laurent series, the residue theorem, conformal mapping, and applications. Formerly MATH 230.

MATH 470 Differential Forms 3.0 Fall

Prerequisites: MATH 220. MATH 260 (or concurrent enrollment) is recommended.

Cartan's exterior calculus in n -dimensional space. Applications to Maxwell's equations, thermodynamics, potential theory, the heat equations, and flux transport. Suitable for engineering, physics, chemistry and mathematics majors. Formerly MATH 208.

MATH 472 Introduction to Chaotic Dynamical Systems 3.0 EvenSp

Prerequisites: MATH 260; MATH 360 and MATH 335 are recommended.

An introduction to the study of non-linear dynamical systems. Both discrete and continuous systems will be studied using classical analysis combined with geometric techniques and computer simulation. Areas of application include fractal geometry, coding theory, fluid turbulence, population fluctuation, and chaotic vibrations of structures and circuits. Formerly MATH 260A.

MATH 473 Fourier Transforms and the FFT 3.0 Inquire

Prerequisites: MATH 260.

The Fourier transform and its properties. Inversion, convolution, correlation, Parseval's theorem, band-limited functions, sampling theorem, and uncertainty principles. The discrete Fourier transform using the FFT. Application to rapid convolution, the estimation of Fourier series coefficients, power spectra, and frequency response. Formerly MATH 260B.

MATH 474 Game Theory 3.0 OddSp

Prerequisites: MATH 260; MATH 335 is recommended.

Introduction to mathematical models of competition, conflict, and decision-making. Games involving risk and uncertainty will be analyzed using the Minimax Theorem and linear programming. Multi-state games and continuous games will be studied using difference equations and differential forms. Formerly MATH 260C.

MATH 475 Calculus of Variations 3.0 OddFa

Prerequisites: MATH 260; MATH 361 is recommended.

Classical problems in the calculus of variations. Euler-Lagrange equations. Isoperimetric problems, Fermat's principle. Lagrangian and Hamiltonian mechanics of particles. Two independent variables. Applications to physics and engineering. Formerly MATH 260D.

MATH 480 Mathematical Modeling 3.0 OddSp

Prerequisites: MATH 260, MATH 335.

The translation of real world phenomena into mathematical language. Possible applications include population and competing species models, mathematical theories of war, traffic flow, river pollution, water waves and tidal dynamics, probabilistic and simulation models. Formerly MATH 280.

MATH 495H Honors Reading Course 3.0 Fa/Spr

Prerequisites: Admission to the Department Honors Program, completion of MATH 420 with a grade of B or higher.

Directed reading in an advanced topic under the guidance of an Honors thesis supervisor. The course exceeds the usual level of difficulty associated with undergraduate work. It provides the background necessary to write an Honors thesis. Formerly MATH 299H.

MATH 498 Advanced Topics in Mathematics 1.0-3.0 Fa/Spr

Prerequisites: At least one 300- or 400-level mathematics course appropriate to the subject, faculty permission.

This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See *The Class Schedule* for the specific topic being offered. Formerly MATH 298.

MATH 499H Honors Thesis 3.0 Fa/Spr

Prerequisites: Completion of MATH 495H with a grade of B or higher, and approval by the department Honors adviser and thesis supervisor of the proposed thesis topic.

Preparation of written thesis in mathematics under supervision of Honors thesis adviser. The thesis, based on studies begun in MATH 495H, will require original work beyond that normally required in undergraduate work. Completed written thesis must be approved by the thesis supervisor and Honors adviser. A summary of the thesis will be presented by the student in public lecture. Successful completion of MATH 495H and MATH 499H is one of the requirements for being designated as an Honors graduate in mathematics. Formerly MATH 299I.

MATH 610 Topics in Mathematics for Secondary Teachers: Analysis 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.

Through an array of pedagogical strategies, secondary mathematics teachers explore analysis topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of analysis. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320B.

MATH 615 Statistical Methods for Graduate Research 3.0 OddSp

Prerequisites: MATH 105, MATH 350, MATH 315, or MATH 305 (only one is required).

Introduction to common procedures used to analyze data. Single and two-sample inference, analysis of variance, multiple regression, analysis of co-variance, experimental design, repeated measures, nonparametric procedures, and categorical data analysis. Examples will be drawn from Biology and related disciplines. Statistical computer packages will be introduced. Appropriate for biology, agriculture, nutrition, psychology, social science, and other majors. Formerly MATH 315.

MATH 620 Topics in Mathematics for Secondary Teachers: Geometry 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.

Through an array of pedagogical strategies, secondary mathematics teachers explore geometry appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of geometry. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320E.

MATH 630 Topics in Mathematics for Secondary Teachers: Foundations of Mathematics 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.

Through an array of pedagogical strategies, secondary mathematics teachers explore the foundations of mathematics topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of the foundations of mathematics. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320D.

MATH 633 Topics in Mathematics for Secondary Teachers: Number Theory 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.

Through an array of pedagogical strategies, secondary mathematics teachers explore number theory appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of number theory. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320H.

MATH 635 Topics in Mathematics for Secondary Teachers: Discrete Mathematics 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.

Through an array of pedagogical strategies, secondary mathematics teachers explore discrete mathematics topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of discrete mathematics. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320C.

MATH 637 Topics in Mathematics for Secondary Teachers: History of Mathematics 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.

Through an array of pedagogical strategies, secondary mathematics teachers explore the history of mathematics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of the history of mathematics. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320F.

MATH 640 Topics in Mathematics for Secondary Teachers: Modern Algebra 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.
 Through an array of pedagogical strategies, secondary mathematics teachers explore modern algebra topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of modern algebra. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320A.

MATH 650 Topics in Mathematics for Secondary Teachers: Probability and Statistics 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.
 Through an array of pedagogical strategies, secondary mathematics teachers explore probability and statistics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of probability and statistics. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320L.

MATH 660 Topics in Mathematics for Secondary Teachers: Mathematical Modeling 3.0 Inquire

Prerequisites: Admission to the master's program in mathematics education or instructor permission.
 Through an array of pedagogical strategies, secondary mathematics teachers explore mathematical modeling appropriate for the secondary school curriculum. These topics and strategies provide a basis for the reflective analysis and deepening knowledge of mathematical modeling. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 320G.

MATH 697 Independent Study 1.0-3.0 Fa/Spr

This course is a graduate-level independent study offered for 1.0-3.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 398.

MATH 698 Graduate Advanced Topics in Mathematics 1.0-3.0 Fa/Spr

This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See *The Class Schedule* for the specific topic being offered. You may take this course more than once for a maximum of 3.0 units. Formerly MATH 397.

MATH 699P Master's Project 1.0-3.0 Fa/Spr

This course is offered for 1.0-6.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 399P.

MATH 699T Master's Thesis 1.0-3.0 Fa/Spr

This course is offered for 1.0-6.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units. Formerly MATH 399P.

Mathematics Education Course Offerings

MTHE 601 Research in Mathematics Education 3.0 Summer

Prerequisites: Admission to a master's degree program in mathematics education or permission of instructor.
 This course will examine research in mathematics education that includes areas of teaching, learning, curriculum, and socio-cultural context. Selected research will be critically reviewed for research design and claims. In a culminating project, students will conduct a review on a specific topic in math education research literature. This is a required course in the MA and MS programs in mathematics education. Formerly MTHE 301.

MTHE 680 Research Methods in Mathematics Education and Science Education 3.0 Inquire

Prerequisites: MTHE 601, admission to master's degree program in mathematics education or science teaching.
 The course introduces students to quantitative and qualitative research methods needed to conduct research in mathematics or science education. In addition to examining the characteristics of various types of research, students will be expected to begin to design their own studies, culminating in the completion of a research proposal. This is a required course in the MA and MS programs in mathematics education. Formerly MTHE 380. This course is also offered as NSCT 680.

MTHE 690 Thesis/Project Writing Seminar 1.0-3.0 Fa/Spr

Prerequisites: MTHE 680.
 Formulation and pursuit, with supervision, of advanced projects and theses. The emphasis is on planning, reading, discussing, and evaluating student's manuscript-in-progress. This is a required course in the MA and MS programs in mathematics education. You may take this course more than once for a maximum of 3.0 units. Formerly MTHE 390.

