# DEPARTMENT OF MATHEMATICS

## Mission Statement

The Department of Mathematics is dedicated to research, high-quality instruction and learning, community engagement, and public service. The department embraces excellence and multicultural traditions, with the mission to empower its undergraduate and graduate students, especially those from backgrounds underrepresented in the mathematical sciences.

## General Information

The Department serves as the point of articulation for disciplines across science, technology, and engineering represented in the College of Sciences at UTSA and beyond. The Department is a center for intellectual and creative resources via its diverse group of faculty with the mission to contribute at all levels to socioeconomic development—for Texas, the nation, and the world.

### Program Outcomes

The Department of Mathematics programs provide students the opportunity to:

- Exhibit a knowledge of mathematical concepts, methods, reasoning, and language.
- Communicate mathematical concepts and procedures with clarity and precision.
- Use computational techniques to analyze and synthesize numerical data.
- Solve problems in computational and theoretical mathematics.
- Use mathematical techniques to model real-world processes.

## Degrees

The Department of Mathematics offers three Bachelor of Science (B.S.) degrees: the B.S. in Mathematics, the B.S. in Mathematics for Teaching, and the B.S. in Mathematics of Data and Computing, offered as a joint degree with the Department of Computer Science.

The **B.S. Degree in Mathematics for Teaching** provides students with the mathematical and educational foundations needed for teaching mathematics at the secondary level. Students will take standard courses in mathematics (calculus, discrete mathematics, algebra, analysis, *et al*.) along with general education courses, including clinical teaching, and those in mathematical pedagogy leading to certification. The degree also prepares students for graduate work in mathematics or mathematics education and provides the mathematical expertise needed for many jobs requiring quantitative and problem-solving skills.

The **B.S. Degree in Mathematics** prepares students with the mathematical skills required for graduate study in pure or applied mathematics and for a wide variety of jobs requiring logical reasoning and quantitative and problem-solving skills. The curriculum includes courses in calculus, discrete math, probability and statistics, algebra, analysis, and more. This background is essential for such jobs as financial or data analyst, actuary, industrial mathematician, research analyst, and statistician.

The **B.S. Degree in Mathematics of Computing and Data** combines significant coursework in Computer Science and Mathematics. The Computer Science coursework focuses on data-centric courses such as Data Structures, Analysis of Algorithms, and Database Systems. The Mathematics coursework emphasizes courses that provide the mathematical foundations of computation and data analysis. Examples of key courses include: Abstract Algebra, Discrete Mathematics, Cryptography, Logic and Computability, and Probability. This type of transdisciplinary education prepares the student for occupations that demand highly developed analytical problem-solving skills. There are few academic programs of this type in the world.

All three degrees prepare students to pursue advanced graduate study. The Department of Mathematics also offers a Minor in Mathematics. Students interested in electives in Statistics, a Minor in Applied Statistics, or a Bachelor of Science degree in Statistics, should refer to the Department of Management Science and Statistics in the Alvarez College of Business section of this catalog.

## UTeachSA Teacher Preparation Program

UTeachSA (https://www.utsa.edu/uteachsa/) is the teacher preparation program in the College of Sciences that prepares students to become secondary (middle school and high school) science and mathematics teachers. The Department of Mathematics offers one program leading to teacher certification for the state of Texas: B.S. Mathematics for Teaching.

### Criminal History Policy and Acknowledgement for Teacher Preparation Programs

Teacher preparation programs at UTSA requires fieldwork in public schools, which requires students to be able to pass a criminal background check conducted. It is the responsibility of the student to determine if their criminal history background will present a problem before applying for admission to the teacher preparation program. Students with a problematic criminal history will encounter difficulty in completing any fieldwork requirements and may not be able to complete the program. The University of Texas at San Antonio is required to inform students of the requirements set forth by the Texas Occupation Code, Chapter 53, Sections 53.001 through 53.105 (https://statutes.capitol.texas.gov/Docs/OC/htm/OC.53.htm).

## COS Signature Experiences in Mathematics

The Department of Mathematics offers experiential learning opportunities for undergraduate students in which they can gain real-world experiences, while also learning about the broader impacts of their work within their fields of study. All undergraduate students have the option to participate in a College of Sciences (COS) Signature Experience. Students should contact the Undergraduate Advisor(s) of Record for the Mathematics, Mathematics for Teaching, or Mathematics of Data and Computing majors for a list of relevant signature experiences.

# Bachelor of Science Degree in Mathematics

The Bachelor of Science (B.S.) Degree in Mathematics offers students the opportunity to prepare to provide technical support and conduct research for high-technology industries, government, and private companies.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 120. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All required and elective mathematics, computer science, and statistics courses must be completed with a grade of "C-" or better.

## Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. degree in Mathematics must fulfill University Core Curriculum requirements. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses in order to meet the minimum number of semester credit hours required for this degree.

MAT 1213 may be used to satisfy the core requirement in Mathematics as well as a major requirement.

### Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentarearequirements/)

| | |
|---|---|
| First Year Experience Requirement | 3 |
| Communication | 6 |
| Mathematics | 3 |
| Life and Physical Sciences | 6 |
| Language, Philosophy and Culture | 3 |
| Creative Arts | 3 |
| American History | 6 |
| Government-Political Science | 6 |
| Social and Behavioral Sciences | 3 |
| Component Area Option | 3 |
| **Total Credit Hours** | **42** |

## Gateway Courses

Students pursuing the B.S. degree in Mathematics must successfully complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change their major.

| Code | Title | Credit Hours |
|---|---|---|
| MAT 1213 | Calculus I | 3 |
| MAT 1223 | Calculus II | 3 |

## Mathematics Degree Requirements

| Code | Title | Credit Hours |
|---|---|---|
| **A. Required Mathematics courses** | | |
| MAT 1213 | Calculus I | 3 |
| MAT 1223 | Calculus II | 3 |
| MAT 1313 | Algebra and Number Systems | 3 |
| MAT 2213 | Calculus III | 3 |
| MAT 2233 | Linear Algebra | 3 |
| MAT 2313 | Combinatorics and Probability | 3 |
| MAT 3003 | Discrete Mathematics | 3 |
| MAT 3613 | Differential Equations I | 3 |
| **B. Computer Science courses** | | |
| Select one of the following: | | 3 |
| CS 1063 | Introduction to Computer Programming I | |
| CS 2073 | Computer Programming with Engineering Applications | |
| **C. Required upper-division Mathematics/Statistics courses** | | |
| MAT 3233 | Modern Algebra | 3 |
| MAT 4233 | Modern Abstract Algebra | 3 |
| MAT 3333 | Fundamentals of Analysis and Topology | 3 |
| MAT 3633 | Numerical Analysis | 3 |
| MAT 4213 | Real Analysis I | 3 |
| MAT 4223 | Real Analysis II | 3 |
| MAT 4273 | Topology | 3 |
| STA 3513 | Probability and Statistics | 3 |
| STA 3523 | Mathematical Statistics for Inference | 3 |
| **D. Upper-division courses in mathematics or statistics** | | |
| Select 12 semester credits of upper-division courses in mathematics or statistics approved by the student's advisor | | 12 |
| **E. Electives** | | |
| Select 15 semester credit hours of electives | | 15 |
| **Total Credit Hours** | | **81** |

## Course Sequence Guide for B.S. Degree in Mathematics

This course sequence guide is designed to assist students in completing their B.S. Degree in Mathematics. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

### B.S. in Mathematics – Recommended Four-Year Academic Plan

**First Year**

| Fall | | Credit Hours |
|---|---|---|
| AIS 1243 | AIS: Engineering, Mathematics, and Sciences (core) | 3 |
| MAT 1213 | Calculus I (core) | 3 |
| MAT 1313 | Algebra and Number Systems | 3 |
| WRC 1013 | Freshman Composition I (core) | 3 |
| PHI 2043 | Introductory Logic (core) | 3 |
| | **Credit Hours** | **15** |

| Spring | | |
|---|---|---|
| MAT 1223 | Calculus II | 3 |
| MAT 2313 | Combinatorics and Probability | 3 |
| WRC 1023 | Freshman Composition II (core) | 3 |
| Life & Physical Sciences (core) | | 3 |

| American History (core) | | 3 |
|---|---|---|
| | **Credit Hours** | **15** |
| **Second Year** | | |
| **Fall** | | |
| MAT 2213 | Calculus III | 3 |
| MAT 2233 | Linear Algebra | 3 |
| CS 1063 or CS 2073 | Introduction to Computer Programming I or Computer Programming with Engineering Applications | 3 |
| POL 1013 | Introduction to American Politics (core) | 3 |
| Life and Physical Sciences (core) | | 3 |
| | **Credit Hours** | **15** |
| **Spring** | | |
| MAT 3003 | Discrete Mathematics | 3 |
| MAT 3613 | Differential Equations I | 3 |
| STA 3513 | Probability and Statistics | 3 |
| POL 1133 or POL 1213 | Texas Politics and Society (core) or Civil Rights in Texas and America | 3 |
| Creative Arts (core) | | 3 |
| | **Credit Hours** | **15** |
| **Third Year** | | |
| **Fall** | | |
| MAT 3233 | Modern Algebra | 3 |
| MAT 3333 | Fundamentals of Analysis and Topology | 3 |
| STA 3523 | Mathematical Statistics for Inference | 3 |
| Social & Behavioral Sciences (core) | | 3 |
| Language, Philosophy & Culture (core) | | 3 |
| | **Credit Hours** | **15** |
| **Spring** | | |
| MAT 4213 | Real Analysis I | 3 |
| MAT 4233 | Modern Abstract Algebra | 3 |
| Upper division MAT elective | | 3 |
| Upper division MAT elective | | 3 |
| American History (core) | | 3 |
| | **Credit Hours** | **15** |
| **Fourth Year** | | |
| **Fall** | | |
| MAT 3633 | Numerical Analysis | 3 |
| MAT 4273 | Topology | 3 |
| Upper-division MAT elective | | 3 |
| Free elective | | 3 |
| Free elective | | 3 |
| | **Credit Hours** | **15** |
| **Spring** | | |
| MAT 4223 | Real Analysis II | 3 |
| Upper-division MAT or STA elective | | 3 |
| Free elective | | 3 |
| Free elective | | 3 |

| Free elective | 3 |
|---|---|
| **Credit Hours** | **15** |
| **Total Credit Hours** | **120** |

Note: Some courses are only offered once a year: Fall or Spring. Check with the Department of Mathematics for scheduling of courses.

# Bachelor of Science Degree in Mathematics for Teaching

The Bachelor of Science (B.S.) degree in Mathematics for Teaching is designed to prepare students to be certified mathematics teachers at the secondary or middle grades level. This program integrates a specialized set of mathematics courses with courses from the B.S. in Mathematics, as well as the UTeachSA program, so that students can gain solid foundations in the mathematics and education fields to obtain the 7-12 Mathematics Teaching Certification.

A minimum number of 120 semester credit hours is required for the B.S. in Mathematics for Teaching, including Core Curriculum requirements. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All majors in mathematics are required to complete all required and elective mathematics, computer science, and statistics courses with a grade of "C-" or better.

## Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. degree in Mathematics for Teaching must fulfill University Core Curriculum requirements. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses in order to meet the minimum number of semester credit hours required for this degree.

MAT 1213 may be used to satisfy the core requirement in Mathematics as well as a major requirement.

**Core Curriculum Component Area Requirements (http://catalog.utsa.edu/ undergraduate/bachelorsdegreeregulations/degreerequirements/ corecurriculumcomponentarearequirements/)**

| First Year Experience Requirement | 3 |
|---|---|
| Communication | 6 |
| Mathematics | 3 |
| Life and Physical Sciences | 6 |
| Language, Philosophy and Culture | 3 |
| Creative Arts | 3 |
| American History | 6 |
| Government-Political Science | 6 |
| Social and Behavioral Sciences | 3 |
| Component Area Option | 3 |
| **Total Credit Hours** | **42** |

## Gateway Courses

Students pursuing the B.S. degree in Mathematics for Teaching must successfully complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts,

including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change their major.

| Code | Title | Credit Hours |
|------|-------|-------------|
| MAT 1213 | Calculus I | 3 |
| MAT 1223 | Calculus II | 3 |

## Mathematics for Teaching Degree Requirements

| Code | Title | Credit Hours |
|------|-------|-------------|
| **A. Required Mathematics courses** | | |
| MAT 1213 | Calculus I | 3 |
| MAT 1313 | Algebra and Number Systems | 3 |
| MAT 1223 | Calculus II | 3 |
| MAT 2213 | Calculus III | 3 |
| MAT 2313 | Combinatorics and Probability | 3 |
| MAT 2233 | Linear Algebra | 3 |
| MAT 3613 | Differential Equations I | 3 |
| MAT 3003 | Discrete Mathematics | 3 |
| **B. Specialized Mathematics Courses** | | |
| 21 semester credit hours of specialized mathematics or statistics courses | | |
| MAT 2113 | Functions and Modeling | 3 |
| MAT 3123 | Fundamentals of Geometry | 3 |
| MAT 3333 | Fundamentals of Analysis and Topology | 3 |
| MAT 3233 | Modern Algebra | 3 |
| MAT 4283 | Computing for Mathematics | 3 |
| STA 3003 | Statistical Methods and Applications | 3 |
| MAT 4303 | Capstone Course for Mathematics | 3 |
| **C. Electives** | | |
| 6 semester credit hours of upper division coursework in mathematics or statistics. | | 6 |
| **D. Education Courses** | | |
| 30 semester credit hours of UTeachSA and education courses | | |
| UTE 1111 | Introduction to STEM Teaching Step 1 | 1 |
| UTE 1122 | Introduction to STEM Teaching Step 2 | 2 |
| UTE 3023 | Perspectives on Science and Mathematics | 3 |
| UTE 3203 | Knowing and Learning in Mathematics and Science | 3 |
| UTE 3213 | Classroom Interactions | 3 |
| UTE 4203 | Project-Based Instruction | 3 |
| ESL 3083 | Second Language Teaching and Learning for Grades 7-12 | 3 |
| LTED 3773 | Reading and Writing Across the Disciplines-Grades 7–12 | 3 |
| SPE 3603 | Introduction to Special Education | 3 |
| UTE 4646 | Clinical Teaching | 6 |
| **Total Credit Hours** | | **81** |

***Requirements for students pursuing teacher certification are different from degree requirements.*** In addition to specific course requirements, teacher certification in Texas also requires passing scores on a Texas Success Initiative-approved assessment instrument test and acceptable scores on

the state-mandated exit competency test. Complete information may be obtained in the Teacher Certification Center at UTSA.

## Course Sequence Guide for B.S. Degree in Mathematics for Teaching

This course sequence guide is designed to assist students in completing their B.S. Degree in Mathematics for Teaching. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

### B.S. in Mathematics for Teaching – Recommended Four-Year Academic Plan

**First Year**

| Fall | | Credit Hours |
|------|---|-------------|
| AIS 1243 | AIS: Engineering, Mathematics, and Sciences (core) | 3 |
| MAT 1313 | Algebra and Number Systems | 3 |
| MAT 1213 | Calculus I (core) | 3 |
| UTE 1111 | Introduction to STEM Teaching Step 1 | 1 |
| WRC 1013 | Freshman Composition I (core) | 3 |
| Life & Physical Sciences (core) | | 3 |
| | **Credit Hours** | **16** |

| Spring | | |
|--------|---|---|
| MAT 1223 | Calculus II | 3 |
| UTE 1122 | Introduction to STEM Teaching Step 2 | 2 |
| WRC 1023 | Freshman Composition II (core) | 3 |
| Life & Physical Sciences (core) | | 3 |
| Language, Philosophy & Culture (core) | | 3 |
| | **Credit Hours** | **14** |

| Summer | | |
|--------|---|---|
| Social & Behavioral Sciences (core) | | 3 |
| | **Credit Hours** | **3** |

**Second Year**

| Fall | | |
|------|---|---|
| MAT 2213 | Calculus III | 3 |
| MAT 2313 | Combinatorics and Probability | 3 |
| UTE 3203 | Knowing and Learning in Mathematics and Science | 3 |
| POL 1013 | Introduction to American Politics (core) | 3 |
| Creative Arts (core) | | 3 |
| | **Credit Hours** | **15** |

| Spring | | |
|--------|---|---|
| MAT 2233 | Linear Algebra | 3 |
| STA 3003 | Statistical Methods and Applications | 3 |
| UTE 2113 | Functions and Modeling | 3 |
| UTE 3213 | Classroom Interactions | 3 |

| | | |
|---|---|---|
| POL 1133 or POL 1213 | Texas Politics and Society (core) or Civil Rights in Texas and America | 3 |
| | **Credit Hours** | **15** |
| **Summer** | | |
| MAT 4283 | Computing for Mathematics | 3 |
| MAT 3613 | Differential Equations I | 3 |
| | **Credit Hours** | **6** |
| **Third Year** | | |
| **Fall** | | |
| MAT 3123 | Fundamentals of Geometry | 3 |
| MAT 3233 | Modern Algebra | 3 |
| UTE 3023 | Perspectives on Science and Mathematics | 3 |
| PHI 2043 | Introductory Logic (core) | 3 |
| American History (core) | | 3 |
| | **Credit Hours** | **15** |
| **Spring** | | |
| MAT 3333 | Fundamentals of Analysis and Topology | 3 |
| ESL 3083 | Second Language Teaching and Learning for Grades 7-12 | 3 |
| SPE 3603 | Introduction to Special Education | 3 |
| Upper division MAT/STA elective | | 3 |
| American History (core) | | 3 |
| | **Credit Hours** | **15** |
| **Fourth Year** | | |
| **Fall** | | |
| MAT 4303 | Capstone Course for Mathematics | 3 |
| LTED 3773 | Reading and Writing Across the Disciplines-Grades 7–12 | 3 |
| UTE 4203 | Project-Based Instruction | 3 |
| Upper division MAT/STA elective | | 3 |
| Free elective | | 3 |
| | **Credit Hours** | **15** |
| **Spring** | | |
| UTE 4646 | Clinical Teaching | 6 |
| | **Credit Hours** | **6** |
| | **Total Credit Hours** | **120** |

Note: Some courses are only offered once a year: Fall or Spring. Check with the Department of Mathematics for scheduling of courses.

# Bachelor of Science Degree in Mathematics of Data and Computing

The Bachelor of Science (B.S.) degree in Mathematics of Data and Computing is offered as a joint program with the Department of Computer Science. The Mathematics of Data and Computing degree prepares students with strong interests in both mathematics and computer science to work in areas involving data science, data analysis, or computational mathematics.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 120. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level.

All required and elective mathematics, computer science, and statistics courses must be completed with a grade of "C-" or better.

## Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. degree in Mathematics of Data and Computing must fulfill University Core Curriculum requirements. If courses are taken to satisfy both degree requirements and the Core Curriculum requirements, then students may need to take additional courses in order to meet the minimum number of semester credit hours required for this degree.

MAT 1213 may be used to satisfy the core requirement in mathematics as well as a major requirement.

**Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentarearequirements/)**

| | |
|---|---|
| First Year Experience Requirement | 3 |
| Communication | 6 |
| Mathematics | 3 |
| Life and Physical Sciences | 6 |
| Language, Philosophy and Culture | 3 |
| Creative Arts | 3 |
| American History | 6 |
| Government-Political Science | 6 |
| Social and Behavioral Sciences | 3 |
| Component Area Option | 3 |
| **Total Credit Hours** | **42** |

## Gateway Courses

Students pursuing the B.S. degree in Mathematics of Data and Computing must successfully complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change their major.

| Code | Title | Credit Hours |
|---|---|---|
| MAT 1213 | Calculus I | 3 |
| MAT 1223 | Calculus II | 3 |
| CS 2123 | Data Structures | 3 |
| CS 2713 | Computer Programming in C | 3 |

## Mathematics of Data and Computing Degree Requirements

All candidates for the B.S. degree in Mathematics of Data and Computing must complete the following 24 semester credit hours of required courses in computer science, 39 hours of required courses in mathematics (this includes the 3 semester credit hours of the Core Curriculum requirement in mathematics), and 18 hours of upper-division computer science or mathematics coursework.

| Code | Title | Credit Hours |
|------|-------|--------------|
| **A. Computer Science courses** | | |
| CS 1083 | Programming I for Computer Scientists | 3 |
| CS 2113 | Fundamentals of Object-Oriented Programming | 3 |
| CS 2123 | Data Structures | 3 |
| CS 2713 | Computer Programming in C | 3 |
| CS 3343 | Design and Analysis of Algorithms | 3 |
| CS 3443 | Application Programming | 3 |
| CS 3423 | Systems Programming | 3 |
| CS 3743 | Database Systems | 3 |
| **B. Mathematics courses** | | |
| MAT 1213 | Calculus I | 3 |
| MAT 1313 | Algebra and Number Systems | 3 |
| MAT 1223 | Calculus II | 3 |
| MAT 2313 | Combinatorics and Probability | 3 |
| MAT 2253 | Applied Linear Algebra | 3 |
| MAT 3003 | Discrete Mathematics | 3 |
| MAT 4033 | Linear Algebra II | 3 |
| MAT 3233 | Modern Algebra | 3 |
| MAT 3313 | Logic and Computability | 3 |
| MAT 4353 | Mathematical Foundations of Cryptography | 3 |
| MDC 4153 | Mathematical Foundations of Data Analytics | 3 |
| MAT 4323 | Applied Graph Theory | 3 |
| MAT 4343 | Introduction to Optimization | 3 |
| **C. Upper Division Computer Science/Mathematics Electives** | | |
| Students must complete 18 hours of upper-division computer science or mathematics electives as approved by the Undergraduate Advisor of Record in either the Computer Science or Mathematics Department. | | 18 |
| **Total Credit Hours** | | **81** |

## Course Sequence Guide for B.S. Degree in Mathematics of Data and Computing

This course sequence guide is designed to assist students in completing their B.S. Degree in Mathematics of Data and Computing. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

### B.S. in Mathematics of Data and Computing – Recommended Four-Year Academic Plan

**First Year**

**Fall**

| | | Credit Hours |
|------|-------|--------------|
| AIS 1243 | AIS: Engineering, Mathematics, and Sciences (core) | 3 |
| MAT 1313 | Algebra and Number Systems | 3 |
| MAT 1213 | Calculus I (core) | 3 |
| WRC 1013 | Freshman Composition I (core) | 3 |
| CS 1083 | Programming I for Computer Scientists | 3 |
| **Credit Hours** | | **15** |

**Spring**

| | | |
|------|-------|--------------|
| MAT 1223 | Calculus II | 3 |
| CS 2113 | Fundamentals of Object-Oriented Programming | 3 |
| CS 2713 | Computer Programming in C | 3 |
| WRC 1023 | Freshman Composition II (core) | 3 |
| Life and Physical Sciences (core) | | 3 |
| **Credit Hours** | | **15** |

**Second Year**

**Fall**

| | | |
|------|-------|--------------|
| MAT 2253 | Applied Linear Algebra | 3 |
| MAT 2313 | Combinatorics and Probability | 3 |
| CS 2123 | Data Structures | 3 |
| Life and Physical Sciences (core) | | 3 |
| Language, Philosophy, and Culture (core) | | 3 |
| **Credit Hours** | | **15** |

**Spring**

| | | |
|------|-------|--------------|
| MAT 3003 | Discrete Mathematics | 3 |
| CS 3343 | Design and Analysis of Algorithms | 3 |
| CS 3423 | Systems Programming | 3 |
| MDC 1213 | Sociocultural Foundations of Mathematics, Data Science, and Computing (core) | 3 |
| POL 1013 | Introduction to American Politics (core) | 3 |
| **Credit Hours** | | **15** |

**Third Year**

**Fall**

| | | |
|------|-------|--------------|
| MAT 3233 | Modern Algebra | 3 |
| MAT 4033 | Linear Algebra II | 3 |
| CS 3443 | Application Programming | 3 |
| CS 3743 | Database Systems | 3 |
| POL 1133 or POL 1213 | Texas Politics and Society (core) or Civil Rights in Texas and America | 3 |
| **Credit Hours** | | **15** |

**Spring**

| | | |
|------|-------|--------------|
| MAT 3313 | Logic and Computability | 3 |
| MDC 4153 | Mathematical Foundations of Data Analytics | 3 |
| Approved upper-division CS/MAT elective | | 3 |
| American History (core) | | 3 |
| **Credit Hours** | | **12** |

**Fourth Year**

**Fall**

| | | |
|------|-------|--------------|
| MAT 4323 | Applied Graph Theory | 3 |
| Approved upper-division CS/MAT elective | | 3 |
| Approved upper-division CS/MAT elective | | 3 |
| Creative Arts (core) | | 3 |
| American History (core) | | 3 |

| | | |
|---|---|---:|
| Social and Behavioral Science (core) | | 3 |
| | **Credit Hours** | **18** |
| **Spring** | | |
| MAT 4353 | Mathematical Foundations of Cryptography | 3 |
| MAT 4343 | Introduction to Optimization | 3 |
| Approved upper-division CS/MAT elective | | 3 |
| Approved upper-division CS/MAT elective | | 3 |
| Approved upper-division CS/MAT elective | | 3 |
| | **Credit Hours** | **15** |
| | **Total Credit Hours** | **120** |

# Minor in Mathematics

All students pursuing the Minor in Mathematics must complete 21 semester credit hours. All required and elective mathematics, computer science, and statistics courses must be completed with a grade of "C-" or better.

| Code | Title | Credit Hours |
|---|---|---:|
| **A. Required courses** | | |
| MAT 1213 | Calculus I | 3 |
| MAT 1223 | Calculus II | 3 |
| MAT 2213 | Calculus III [1] | 3 |
| or CS 3333 | Mathematical Foundations of Computer Science | |
| MAT 2233 | Linear Algebra | 3 |
| MAT 3613 | Differential Equations I [2] | 3 |
| **B. Approved upper-division mathematics electives** | | |
| Select a minimum of 6 semester credit hours of approved upper-division mathematics electives | | 6 |
| **Total Credit Hours** | | **21** |

[1] For Computer Science majors, substitute CS 3333 Mathematical Foundations of Computer Science.

[2] Computer Science majors may substitute 3 hours of an approved upper-division mathematics elective.

To declare a Minor in Mathematics, obtain advice, or seek approval of substitutions for course requirements, students should consult their academic advisor and the Undergraduate Advisor of Record for the Department of Mathematics.

# Mathematics (MAT) Courses

**MAT 1023. College Algebra with Applications. (3-0) 3 Credit Hours. (TCCN = MATH 1314)**

Prerequisite: Satisfactory performance on a placement examination; students pursuing majors in the College of Science or in Engineering should not enroll in this course; students majoring in areas that require MAT 1213 Calculus I are encouraged to take MAT 1073 instead of MAT 1023. Topics include algebraic expressions; equations; inequalities over the real numbers; relations, functions, and graphs; polynomial and rational functions; systems of linear equations and inequalities; complex numbers; and matrices and determinants. A wide range of applications will be included in this course. (Formerly MTC 1023 and MAT 1063. Credit can be earned for only one of the following: MAT 1023, MTC 1023, MAT 1063, or MAT 1073 (formerly MTC 1073). NOTE: For the purpose of the Three-Attempt Rule, these courses are considered to be equivalent, and additional fees may be charged for the third or subsequent attempt to take any of these courses in any combination.) May apply toward the Core Curriculum requirement in Mathematics. Generally offered: Fall, Spring, Summer. Course Fee: LRC1 $12; LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 1043. Quantitative Reasoning. (3-0) 3 Credit Hours. (TCCN = MATH 1332)**

Prerequisite: Satisfactory performance on a placement examination; this course is designed primarily for the liberal arts major to satisfy the Core Curriculum Mathematics requirement. Topics may include logic; proofs; deductive and inductive reasoning; number theory; fundamentals of statistics; basic statistical graphs; causal connections; financial management; functions; linear graphs and modeling; exponential growth and decay; logarithms; fundamentals of probability; fundamentals of geometry; and basic ideas from trigonometry, calculus, and discrete mathematics. (Formerly MTC 1043. Credit cannot be earned for both MAT 1043 and MTC 1043.) May apply toward the Core Curriculum requirement in Mathematics. Generally offered: Fall, Spring, Summer. Course Fees: LRC1 $12; LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 1053. Mathematics for Business. (3-0) 3 Credit Hours. (TCCN = MATH 1324)**

Prerequisite: Satisfactory performance on a placement examination. This course is designed to prepare the student for MAT 1133 Calculus for Business. Topics include the application of common algebraic functions, including polynomial, exponential, logarithmic, and rational, to problems in business, economics, statistics, finance, and accounting. The applications include mathematics of finance, including simple and compound interest and annuities; systems of linear equations; matrices; linear programming; and probability, including expected value. May apply toward the Core Curriculum requirement in Mathematics. Generally offered: Fall, Spring, Summer. Course Fees: LRC1 $12; LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 1073. Algebra for Scientists and Engineers. (1-6) 3 Credit Hours. (TCCN = MATH 1314)**
Prerequisite: Satisfactory performance on a placement examination. This course is designed to prepare the student for MAT 1093 Precalculus and MAT 1213 Calculus I. Topics may include algebraic expressions; equations; inequalities over the real numbers; relations; functions; polynomial and rational functions; logarithmic and exponential functions; systems of linear equations and inequalities; matrices and determinants; complex numbers; sequences; series binomial expansion; mathematical induction; permutations, and combinations. (Formerly MTC 1073. Credit can be earned for only one of the following: MAT 1073, MTC 1073, MAT 1023 (formerly MAT 1063 and MTC 1023). NOTE: For the purpose of the Three-Attempt Rule, these courses are considered to be equivalent and additional fees may be charged for the third or subsequent attempt to take any of these courses in any combination.) May apply toward the Core Curriculum requirement in Mathematics. Generally offered: Fall, Spring, Summer. Course Fee: LRC1 $12; LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 1093. Precalculus. (3-0) 3 Credit Hours. (TCCN = MATH 2312)**
Prerequisite: MAT 1023, MAT 1053, or MAT 1073, or satisfactory performance on a placement examination. Exponential functions, logarithmic functions, trigonometric functions, complex numbers, DeMoivre's theorem, and polar coordinates. May apply toward the Core Curriculum requirement in Mathematics. Generally offered: Fall, Spring, Summer. Course Fees: DL01 $75; LRC1 $12; LRS1 $46.20; STSI $21.60.

**MAT 1133. Calculus for Business. (3-0) 3 Credit Hours. (TCCN = MATH 1325)**
Prerequisite: MAT 1023, MAT 1053, or MAT 1073 (with a grade of "C-" or better), or satisfactory performance on a placement examination. This course is the basic study of limits and continuity, differentiation of single and multivariable functions, optimization and graphing, and integration of elementary, single variable functions, with an emphasis on applications in business and economics. May apply toward the Core Curriculum requirement in Mathematics. (Formerly MAT 1033. Credit cannot be earned for both MAT 1033 and MAT 1133.) Generally offered: Fall, Spring, Summer. Course Fees: DL01 $75; LRC1 $12; LRS1 $46.20; STSI $21.60.

**MAT 1153. Essential Elements in Mathematics I. (3-0) 3 Credit Hours. (TCCN = MATH 1350)**
Prerequisite: MAT 1023 or MAT 1073. Numeration systems; properties of the systems of whole numbers, integers, rational numbers, and real numbers; problem solving; logic. May not be applied toward a major in mathematics. (Formerly MAT 1143. Credit cannot be earned for both MAT 1153 and MAT 1143.) Generally offered: Fall, Spring, Summer. Course Fees: LRS1 $46.20; MFSM $30; STSI $21.60; DL01 $75.

**MAT 1163. Essential Elements in Mathematics II. (3-0) 3 Credit Hours. (TCCN = MATH 1351)**
Prerequisite: MAT 1153. Algebra, statistics and probability; geometric shapes; measurement; coordinate and transformational geometry. May not be applied toward a major in mathematics. Generally offered: Fall, Spring, Summer. Course Fees: LRS1 $46.20; MFSM $30; STSI $21.60; DL01 $75.

**MAT 1193. Calculus for the Biosciences. (3-0) 3 Credit Hours. (TCCN = MATH 2313)**
Prerequisite: MAT 1093 or an equivalent course or satisfactory performance on a placement examination. An introduction to calculus is presented using discrete-time dynamical systems and differential equations to model fundamental processes important in biological and biomedical applications. Specific topics to be covered are limits, continuity, differentiation, antiderivatives, definite and indefinite integrals, the fundamental theorem of calculus, differential equations, and the phase-plane. (Formerly MAT 1194. Same as MAT 1214 and MAT 1213. Credit can be earned for only one of the following: MAT 1193, MAT 1194, MAT 1213, or MAT 1214.) May apply toward the Core Curriculum requirement in Mathematics. Generally offered: Fall, Spring, Summer. Course Fee: DL01 $75; LRC1 $12; LRS1 $46.20; STSI $21.60.

**MAT 1213. Calculus I. (3-0) 3 Credit Hours. (TCCN = MATH 2313)**
Prerequisite: MAT 1093 or equivalent or satisfactory performance on a placement examination. An introduction to the concepts of limit, continuity and derivative, mean value theorem, and applications of derivatives such as velocity, acceleration, maximization, and curve sketching; introduction to the Riemann integral and the fundamental theorem of calculus. (Same as MAT 1214 and MAT 1193. Formerly MAT 1194. Credit can be earned for only one of the following: MAT 1214, MAT 1213, MAT 1193, or MAT 1194.) May apply toward the Core Curriculum requirement in Mathematics. Generally offered: Fall, Spring, Summer. Course Fee: LRC1 $12; LRS1 $46.20; DL01 $75; STSI $21.60.

**MAT 1223. Calculus II. (3-0) 3 Credit Hours. (TCCN = MATH 2314)**
Prerequisites: MAT 1213 (or MAT 1214 in previous catalogs) or MAT 1193, or equivalent. Methods of integration, applications of the integral, sequences, series, and Taylor expansions. (Same as MAT 1224. Credit cannot be earned for both MAT 1223 and MAT 1224.). Course fees: LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 1313. Algebra and Number Systems. (3-0) 3 Credit Hours.**
Prerequisite: Completion of or concurrent enrollment in MAT 1213 (or MAT 1214 in previous catalogs). Basic logic and proofs. Properties of integer numbers, mathematical induction, the fundamental theorem of arithmetic, the infinitude of primes, modular arithmetic, rational and irrational numbers, complex numbers, functions, polynomials, and the binomial theorem. Generally offered: Fall, Spring. Course Fee: LRS1 $46.20; STSI $21.60.

**MAT 2113. Functions and Modeling. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1093 or consent of instructor and admission to the UTeachSA teacher preparation program. In-depth study of concepts needed to teach secondary school mathematics at various levels. Emphasizes the development of the concept of function, exploring function patterns in data sets, and the connections between the main topics of mathematics associated with a secondary school curriculum. Use of appropriate technology is explored. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. (Same as UTE 2113. Credit cannot be earned for both MAT 2113 and UTE 2113.) Course Fees: LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 2213. Calculus III. (3-0) 3 Credit Hours. (TCCN = MATH 2315)**
Prerequisites: MAT 1223 (or MAT 1224 in previous catalogs) or equivalents. Topics may include: Vectors, functions of several variables, partial derivatives, line, surface and volume integrals, Green's, Stokes' and the Divergence theorems. (Same as MAT 2214. Credit can not be earned for both MAT 2213 and MAT 2214.). Course fees: LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 2233. Linear Algebra. (3-0) 3 Credit Hours. (TCCN = MATH 2318)**
Prerequisite: MAT 1223 (or MAT 1224 in previous catalogs) or EGR 2323. Vector spaces and matrix algebra, matrices and determinants, characteristic values of matrices, and reduction to canonical forms. Emphasis on applications. Generally offered: Fall, Spring, Summer. Course Fee: LRS1 $46.20; STSI $21.60; DL01 $75.

**MAT 2253. Applied Linear Algebra. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1213 (or MAT 1214 in previous catalogs) or equivalent. Topics may include (1) applications to optimization, data analysis, and neural networks, (2) Linear systems of equations, vectors, and matrices, (3) Eigenvalues, eigenvectors, and canonical solutions to linear systems of differential equations, and (4) Techniques of calculus operations in vectors and matrices, optimization, and Taylor series in one and multiple variables.

**MAT 2313. Combinatorics and Probability. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1223 (or MAT 1224 in previous catalogs) or equivalent. Topics may include permutations, combinations, multinomial coefficients, inclusion/exclusion principle, axioms of probability, conditional probability, Bayes formula, independent events, discrete random variables, expected value, variance, discrete random variables (Bernoulli, Binomial, Poisson, geometric, hypergeometric, and Zeta random variables), continuous random variables (uniform, normal, and other distributions), joint distributions, properties of expectations, and limit theorems (Chebyshev's inequality, Central Limit Theorem, and Law of Large Numbers). Course Fee: LRS1 $46.2; STSI $21.6; DL01 $75.

**MAT 3003. Discrete Mathematics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1313 or CS 2233 or consent of instructor. The course may include (1) Propositional logic, (2) Predicate Logic, (3) Sets and Boolean algebras, (4) Relations, ordered sets, and bounds, (5) Functions, operations of functions, and their images and inverses, (6) Well-ordered sets, induction and choice functions, and (7) Introduction to computability, classical and contemporary models of computation, and limitations of computation. This course has Differential Tuition.

**MAT 3013. Foundations of Mathematics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1213 (or MAT 1214 in previous catalogs). Development of theoretical tools for rigorous mathematics. Topics may include mathematical logic, propositional and predicate calculus, set theory, functions and relations, cardinal and ordinal numbers, Boolean algebras, and construction of the natural numbers, integers, and rational numbers. Emphasis on theorem proving. (Formerly MAT 2243. Credit cannot be earned for MAT 3013 and MAT 2243.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 3023. Perspectives on Science and Mathematics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1193, MAT 1213 (or MAT 1214 in previous catalogs), STA 1053, or consent of instructor. An examination of important episodes in the history of mathematics and science that illustrate the nature of scientific inquiry and convey that scientific and mathematical concepts are not static. Topics may include Galileo's conflict with the Catholic Church, Isaac Newton's formulation of the laws of motion and invention of calculus, Charles Darwin's proposal of the theory of evolution by natural selection, the development of the atomic bomb, and the discovery of the double helix structure of DNA, or others chosen by the instructor. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. (Same as UTE 3023. Credit cannot be earned for both MAT 3023 and UTE 3023. Credit cannot be earned for both MAT 3023 and MAT 4123.) This course has Differential Tuition.

**MAT 3103. Data Analysis and Interpretation. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1093 or consent of instructor. Measurement, sampling, summarizing and displaying data, types of data, inferential methods, nonparametric methods, qualitative research designs and methods, interpreting research results, and research design. Applications to research techniques in school-based settings will be emphasized. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 3123. Fundamentals of Geometry. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1093 or consent of instructor. A survey of geometric concepts, including axiomatic development of advanced Euclidean geometry, coordinate geometry, non-Euclidean geometry, three-dimensional geometry, and topology. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. Generally offered: Fall, Spring. This course has Differential Tuition.

**MAT 3213. Foundations of Analysis. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1223 (or MAT 1224 in previous catalogs), and MAT 3013. Axiomatic definition of real numbers, including order properties and completeness; infinite sequences and their convergence; basic notions related to series and their convergence; functions and function limits. Introduction to topology of the real line. Emphasis on theorem proving. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 3223. Complex Variables. (3-0) 3 Credit Hours.**
Prerequisite: MAT 2213 (or MAT 2214 in previous catalogs), and MAT 3213. An introduction to complex variables, including elementary functions, line integrals, power series, residues and poles, and conformal mappings. Generally offered: Spring. This course has Differential Tuition.

**MAT 3233. Modern Algebra. (3-0) 3 Credit Hours.**
Prerequisite: MAT 2233 or MAT 3003 or equivalent. An introduction to modern algebra building up from concrete examples in elementary algebra and number theory which lead to the abstract theory of groups, rings, and fields. Topics include arithmetic congruences in the ring of integers; residue rings modulo n; finite fields; the group of units; cyclic groups; the Chinese Remainder Theorem, Fermat's and Euler's theorems; polynomial rings; the Fundamental Theorem of Algebra; irreducible polynomials and factorization in polynomial rings; and quotient rings and construction of the Galois fields. This course has Differential Tuition.

**MAT 3273. Applied Mathematics for Sciences and Engineering. (3-0) 3 Credit Hours.**
Prerequisite: MAT 2213 (or MAT 2214 in previous catalogs) or MAT 3613 or consent of instructor. Mathematical applications in biology, physics, engineering or other scientific disciplines. Topics may employ techniques of complex analysis, harmonic analysis, Fourier series, Fourier transforms, and partial differential equations. This course has Differential Tuition. Course Fee: LRS1 $46.20; STSI $21.60.

**MAT 3313. Logic and Computability. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1213 (or MAT 1214 in previous catalogs) and MAT 3013. Recursive functions, Turing computability, insolvability, decidability, completeness and compactness of first order logic. Generally offered: Spring. This course has Differential Tuition.

**MAT 3333. Fundamentals of Analysis and Topology. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1223 (or MAT 1224 in previous catalogs), and MAT 3003, or consent of instructor. Topics may include topological notions in the real line and in metric spaces, convergent sequences, continuous functions, connected and compact sets, the Intermediate Value and Extreme Value theorems, sequential compactness, and the Heine-Borel Theorem. This course has Differential Tuition.

**MAT 3613. Differential Equations I. (3-0) 3 Credit Hours.**
Prerequisite: Completion of or concurrent enrollment in MAT 2233. Basic notions of differential equations, solution of first-order equations and linear equations with constant coefficients, nth-order initial value problems, Laplace transforms, and may include additional topics such as power series solutions of differential equations, linear systems, and stability. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 3623. Differential Equations II. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3613. Continuation of MAT 3613. May include topics in stability, linear systems, power series solutions, partial differential equations, and boundary value problems. Generally offered: Spring. This course has Differential Tuition.

**MAT 3633. Numerical Analysis. (3-0) 3 Credit Hours.**
Prerequisites: MAT 2233, MAT 3213, and one of the following: CS 1063, CS 2713 (or CS 1714 in previous catalogs), or CS 2073. Solution of linear and nonlinear equations, curve-fitting, and eigenvalue problems. Generally offered: Fall, Spring. This course has Differential Tuition. Course fee: DL01 $75.

**MAT 3653. Stochastic Calculus. (3-0) 3 Credit Hours.**
Prerequisite: STA 3513. Probability, random walk, Brownian motion, stationary and evolutionary processes and stochastic differential equations. This course has Differential Tuition. Course Fee: LRS1 $46.20; STSI $21.60.

**MAT 4033. Linear Algebra II. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3003 or CS 2233, or instructor consent. Topics may include 1) Finite-dimensional vector spaces: Vector space axioms, subspaces, linear independence and bases, dimension, sums, and quotients of vector spaces, 2) Linear transformations: Rank and nullity, isomorphisms, bases, and change of basis, 3) Gauss-Jordan elimination: Row operations, echelon forms, and determinants, 4) Inner product spaces: Projections, orthogonal bases and Gram-Schmidt, least squares approximation, and Riesz representation, 5) Eigenvalues and eigenspaces: Characteristic polynomials and diagonalization, and 6) Jordan form and spectral representation. This course has Differential Tuition.

**MAT 4113. Computer Mathematical Topics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1213 (or MAT 1214 in previous catalogs). Mathematical topics from algebra, Euclidean and non-Euclidean geometry, number theory, and probability and statistics will be investigated using Geometer's Sketchpad and a variety of Web-based mathematics resources. Course will also include the application of software to the solution of a variety of geometric and algebraic problems. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. Generally offered: Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75; MFSM $30.

**MAT 4123. History of Mathematics. (3-0) 3 Credit Hours.**
Prerequisites: MAT 3233 or MAT 4233, and either MAT 3123 or MAT 4263. Selected subjects in mathematics developed through historical perspectives and biographies. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. (Same as UTE 3023. Credit cannot be earned for both UTE 3023 and MAT 4123.) Generally offered: Spring, Summer. This course has Differential Tuition. Course Fee: LRS1 $46.20; STSI $21.60.

**MAT 4133. Mathematical Biology. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1193 or equivalent or consent of instructor. A broad introduction to nonlinear dynamics. Topics may include discrete and continuous models, flows on the line, linear stability analysis, matrix operations and eigenvalues, flows on the plane, bifurcations, discrete dynamical systems, higher-dimensional systems, and others. The biological problems studied include molecular processes (glycolysis, lactose operon, etc.), physiological processes (single neuron), and ecological processes (predator-prey, competing species, infectious disease modeling). (Same as MAT 5133. Credit can not be earned for both MAT 4133 and MAT 5133.) This course has Differential Tuition.

**MAT 4153. Mathematical Foundations of Data Analytics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 2253, or MAT 2233 and MAT 2213 (or MAT 2214 in previous catalogs). This immersive Data Analytics course equips students with the essential mathematical skills and knowledge required to analyze, visualize, and interpret complex datasets. Students will be exposed to the entire life cycle of data analysis. Throughout the course, participants will explore basic operations in scripting languages, delve into advanced visualization techniques, and investigate linear discriminants, generalized regressions, time series analysis, non-linear discriminants, and clustering. Students will program essential algorithms, instead of using toolboxes, to explore the discrete Fourier transform, generalized regressions, clustering algorithms, and artificial neural networks. Furthermore, the course will provide an understanding of relational databases and their integration with programming environments, as well as guidance on creating effective data analysis plans. Emphasis will be placed on solution architecture, reproducibility, configuration management, and generating standardized reports. By the end of the course, students will have a strong foundation in data analytics, allowing them to transform raw data into valuable insights for decision-making. This course is intended for Mathematics, Mathematics for Data and Computing, and Mathematics for Teaching majors. (Same as MDC 4153. Credit cannot be earned for both MAT 4153 and MDC 4153.) This course has Differential Tuition.

**MAT 4213. Real Analysis I. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3333. Continuous functions, uniform continuity; theory of differentiation; applications of the derivative to properties of functions; antiderivatives; Riemann integral; connection between differentiation and integration. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 4223. Real Analysis II. (3-0) 3 Credit Hours.**
Prerequisite: MAT 4213. This course will cover n-dimensional spaces, vectors, calculus of functions of several variables, and multidimensional integration. Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 4233. Modern Abstract Algebra. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3233 or equivalent. Basic properties and examples of semigroups, monoids, and groups, detailed study of permutation, dihedral, and congruence groups, cyclic groups, normal subgroups, quotient groups, homomorphism, isomorphism theorems, direct products of groups, rings and fields and their basic properties, ideals, polynomial rings. Generally offered: Spring. This course has Differential Tuition.

**MAT 4263. Geometry. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3013. A study of non-Euclidean geometries, including spherical geometry, hyperbolic geometry and others. Generally offered: Spring. This course has Differential Tuition. Course fee: DL01 $75.

**MAT 4273. Topology. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3333. Set theory, including cardinal and ordinal numbers. Topological properties of the real-line and metric spaces. Generally offered: Fall. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 4283. Computing for Mathematics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1313 or consent of instructor. Project-based modular course allowing individualized learning of computer tools and skills most relevant to each mathematics student. Available modules include calculation and visualization in Desmos and GeoGebra, an introduction to general-purpose programming in Python, and specialized tools including Sage, Mathematica, Matlab/Octave, R, etc. This course has Differential Tuition.

**MAT 4303. Capstone Course for Mathematics. (3-0) 3 Credit Hours.**
Prerequisite: Consent of instructor or one each from MAT 3123 or MAT 4263, MAT 3233 or MAT 4233, and MAT 4113. This course is for any interested mathematics major, particularly for those students who intend to pursue secondary certification in Mathematics. The goals of the course are to enable students to build connections among the mathematical areas they have studied and between undergraduate mathematics and high school mathematics, to develop their understanding of mathematics as an integrated discipline, and to strengthen their oral and written communication skills in mathematics. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 4323. Applied Graph Theory. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3003. Isomorphism, planarity, computer representation of graphs, covering circuits and graph colorings, Euler and Hamiltonian graphs, trees and searching network algorithms (shortest paths, connectivity, traveling salesman, network flow, matching, sorting, etc.). This course has Differential Tuition. Course fees: LRS1 $46.20; STSI $21.60.

**MAT 4333. Probability and Computing. (3-0) 3 Credit Hours.**
Prerequisite: CS 3333 or MAT 2313. May include moments of random variables: randomized mincut algorithm, Chebyshev and Markov inequalities, sampling estimator for mean. Basic Concentration Inequalities: Chernoff and Hoeffding inequalities; parameter estimation and set balancing. Discrete probabilistic structures: Bucket sort algorithm, Poisson approximation, Lovasz local Lemma, independent set search. The Gaussian: Moment Generating Functions, Central Limit Theorem, JL dimensionality reduction lemma. Markov Chains and Random Walks: Stationary Distributions, and randomized 3-SAT algorithm, Entropy Function: Information and Compression. Same as CS 4333. Credit cannot be earned for both CS 4333 and MAT 4333. Generally offered in Springs. This course has Differential Tuition.

**MAT 4343. Introduction to Optimization. (3-0) 3 Credit Hours.**
Prerequisite: MAT 2213 (or MAT 2214 in previous catalogs) and MAT 2233, or EGR 3323, or MAT 1223 (or MAT 1224 in previous catalogs) and CS 3333. May include Discrete, Continuous, Linear, and non-Linear optimization. Optimality conditions, Lagrange multipliers, duality theory. Applications of linear programming in computer science and discrete optimization. Gradient descent and Newton iteration (i.e., RST and second order methods), trust region methods, and conjugate gradient. Applications of RST and second order methods to engineering. Same as CS 4303. Credit cannot be earned for both CS 4303 and MAT 4343. Generally offered in Fall. This course has Differential Tuition.

**MAT 4353. Mathematical Foundations of Cryptography. (3-0) 3 Credit Hours.**
Prerequisite: MAT 3233 or MAT 4233 or consent of instructor. Congruences and residue class rings, Fermat's Little Theorem, the Euler phi-function, the Chinese Remainder Theorem; complexity; symmetric-key cryptosystems; cyclic groups, primitive roots, discrete logarithms, one-way functions; public-key cryptosystems (Diffie-Hellman key exchange, RSA, Rabin, El Gamal); digital signatures; and other groups (finite fields, elliptic curves). Generally offered: Spring. This course has Differential Tuition. Course Fee: DL01 $75.

**MAT 4803. Statistical Quality Control. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1223 (or MAT 1224 in previous catalogs), and STA 3003 or STA 3513. Statistical methods are introduced in terms of problems that arise in manufacturing and their applications to the control of manufacturing processes. Topics include control charts and acceptance sampling plans. (Same as STA 4803. Credit cannot be earned for both MAT 4803 and STA 4803.) This course has Differential Tuition. Course Fee: LRS1 $46.20; STSI $21.60.

**MAT 4813. Foundations of Mathematical Physics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 2213 (or MAT 2214 in previous catalogs), and MAT 3623 or equivalent, or instructor consent. Topics may include (1) Complex analysis in physics, (2) Differential equations: dynamical systems, non-linearity, and chaos, 3) Nonlinear waves in PDEs: continuous systems, Hamiltonian formulation of plasmas and liquids, KdV equation, nonlinear Schroedinger equation, and Sine/Klein-Gordon equation(s), (4) Asymptotic analysis methods and time-dependent/independent perturbation theory, (5) Functional analysis in mathematical physics, (6) Mathematical formalism of PDEs, (7) Group theory and Lie algebras, and (8) Tensor calculus: theory and applications. This course has Differential Tuition.

**MAT 4913. Independent Study. (0-0) 3 Credit Hours.**
Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

**MAT 4953. Special Studies in Mathematics. (3-0) 3 Credit Hours.**
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course fee: DL01 $75.

**MAT 4993. Directed Research. (0-0) 3 Credit Hours.**
Prerequisite: Approval from the instructor, the Department Chair, and Associate Dean of Undergraduate Studies in the College for which this course is offered. Form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. Students may produce a thesis in addition to active research. May be repeated. This course can also be used for students pursuing the COS Undergraduate Thesis Option. This course has Differential Tuition.

## Mathematics of Data and Computing (MDC) Courses

**MDC 1213. Sociocultural Foundations of Mathematics, Data Science, and Computing. (3-0) 3 Credit Hours.**
This introductory survey course for freshmen aims to explore the connections between mathematics, data science, and artificial intelligence, with an emphasis on their roles in shaping and understanding human culture and experience. Students will be guided through a series of 30 lessons that delve into how these fields intersect with ideas, values, beliefs, and other cultural aspects, fostering aesthetic and intellectual creation. Throughout the course, students will have access to the GPT-4 language model to assist with content generation and idea exploration. Course Fee: DL01 $75; LRS1 $45; STSI $21.

**MDC 4153. Mathematical Foundations of Data Analytics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 2253, or MAT 2233 and MAT 2213 (or MAT 2214 in previous catalogs). This immersive Data Analytics course equips students with the essential mathematical skills and knowledge required to analyze, visualize, and interpret complex datasets. Students will be exposed to the entire life cycle of data analysis. Throughout the course, participants will explore basic operations in scripting languages, delve into advanced visualization techniques, and investigate linear discriminants, generalized regressions, time series analysis, non-linear discriminants, and clustering. Students will program essential algorithms, instead of using toolboxes, to explore the discrete Fourier transform, generalized regressions, clustering algorithms, and artificial neural networks. Furthermore, the course will provide an understanding of relational databases and their integration with programming environments, as well as guidance on creating effective data analysis plans. Emphasis will be placed on solution architecture, reproducibility, configuration management, and generating standardized reports. By the end of the course, students will have a strong foundation in data analytics, allowing them to transform raw data into valuable insights for decision-making. This course is intended for Mathematics, Mathematics for Data and Computing, and Mathematics for Teaching majors. (Same as MAT 4153. Credit cannot be earned for both MAT 4153 and MDC 4153.) This course has Differential Tuition.

## UTeachSA (UTE) Courses

**UTE 1111. Introduction to STEM Teaching Step 1. (1-0) 1 Credit Hour.**
Introduces STEM teaching as a career. Discussions include standards and inquiry-based lesson design and various teaching and behavior management strategies. This course requires fieldwork that allows the student to observe and teach in an elementary classroom. Generally offered: Fall, Spring. Course fee: DL01 $25.

**UTE 1122. Introduction to STEM Teaching Step 2. (2-0) 2 Credit Hours.**
Prerequisite: UTE 1111 with a grade of "C-" or better. Further exploration of STEM teaching as a career while building on the knowledge and skills developed in UTE 1111. Emphasis is placed on various teaching methods that are designed to meet instructional goals and learner outcomes. This course requires fieldwork that provides experience observing and teaching in a middle school STEM classroom. Generally offered: Fall, Spring. Course fee: DL01 $50.

**UTE 2113. Functions and Modeling. (3-0) 3 Credit Hours.**
Prerequisites: MAT 1093 or consent of instructor, and admission to the UTeachSA teacher preparation program. In-depth study of concepts needed to teach secondary school mathematics at various levels. Emphasizes the development of the concept of function, exploring function patterns in data sets, and the connections between the main topics of mathematics associated with a secondary school curriculum. Use of appropriate technology is explored. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. (Same as MAT 2113. Credit cannot be earned for both UTE 2113 and MAT 2113).

**UTE 3023. Perspectives on Science and Mathematics. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1193, MAT 1213, STA 1053, or consent of instructor. An examination of important episodes in the history of mathematics and science that illustrate the nature of scientific inquiry and convey that scientific and mathematical concepts are not static. Topics may include Galileo's conflict with the Catholic Church, Isaac Newton's formulation of the laws of motion and invention of calculus, Charles Darwin's proposal of the theory of evolution by natural selection, the development of the atomic bomb, and the discovery of the double helix structure of DNA, or others chosen by the instructor. May not be applied toward the Mathematics Concentration of the B.S. degree in Mathematics. (Same as MAT 3023. Credit cannot be earned for both MAT 3023 and UTE 3023. Credit cannot be earned for both UTE 3023 and MAT 4123). This course has Differential Tuition. Course Fee: DL01 $75.

**UTE 3043. UTeachSA Research Methods. (3-0) 3 Credit Hours.**
Prerequisite: This course is only open to students who are participating in the UTeachSA teacher preparation program. Students design and carry out independent inquiries, which they write up and present in the manner that is common in the scientific community. Inquiries incorporate mathematics and the various science disciplines to solve research problems. (Same as BIO 3043. Credit cannot be earned for more both BIO 3043 and UTE 3043). This course has Differential Tuition.

**UTE 3203. Knowing and Learning in Mathematics and Science. (3-0) 3 Credit Hours.**
Prerequisite: UTE 1111 with a grade of "C-" or better, may be taken concurrently with UTE 1111 or UTE 1122. Critical examination of issues related to what it means to know and learn in STEM classrooms. Emphasis on psychological foundations of learning, problem solving in STEM utilizing technology, principles of expert and novice understandings of subject matter, implications of high-stakes testing, and foundations of formative and summative assessment. This course has Differential Tuition. Course fee: DL01 $75.

**UTE 3213. Classroom Interactions. (3-0) 3 Credit Hours.**
Prerequisites: UTE 1122 and UTE 3203 with grades of "C-" or better. Application of learning theories in STEM instructional settings. Design and implementation of instructional activities informed by students' own understanding of what it means to know and learn mathematics and science, and outcome evaluation on the basis of student artifacts. Opportunities to develop awareness and understanding of equity issues affecting students by examining gender, class, race, culture and other diverse attributes of students and how they impact learning. Includes field experience in a middle or high school classroom. This course has Differential Tuition. Course fee: DL01 $75.

**UTE 4203. Project-Based Instruction. (3-0) 3 Credit Hours.**
Prerequisites: UTE 3213 with a grade of "C-" or better, cumulative GPA of 2.5 or higher, and admission to the Teacher Certification Program. Exploration of project-based learning environments and instructional strategies in STEM classrooms. Discussion of the foundations for designing, managing, organizing, and evaluating project-based curricula and processes in middle and high school classrooms. Includes field experience in a middle or high school classroom. This course has Differential Tuition. Course fee: DL01 $75.

**UTE 4646. Clinical Teaching. (0-0) 6 Credit Hours.**
Prerequisite: Admission to Teacher Certification Program and the clinical teaching semester, and completion of UTE 1111, UTE 1122, UTE 3203, UTE 3213, UTE 4203, and LTED 3773 with a grade of "C-" or better; can lack no more than 6 hours in content subject matter; individuals must apply to the director of clinical teaching one semester in advance. Full semester of full-day clinical teaching in grades 7–12. Student teacher will be responsible for planning, implementing, and evaluating instruction in collaboration with the cooperating teacher and in conjunction with the UTSA supervisor. Individuals pursuing a Basic Secondary Certificate, Concentration A, will student teach in the single teaching field for which certification is sought. Individuals with two teaching fields will student teach in their major teaching field. Seminars explore issues in teaching practice. (Same as CI 4646. Credit cannot be earned for both UTE 4646 and CI 4646). This course has Differential Tuition.