



Mathematical Sciences

Faculty:

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Majors:

- Mathematics
- Computer Science

Minors:

- Mathematics
- Computer Science
- Physics

Other program:

- Pre-engineering

Teaching

Endorsements:

- Computer Science, Grades 6-12
- Mathematics, Grades 6-12

The department of mathematical sciences offers students a variety of options to fit individual interests and career preferences. Major emphasis is placed on preparing students in mathematics and computer science for graduate study, teaching, or a career in business or industry.

A major and a minor are offered in both mathematics and computer science. In addition, secondary education licensure in mathematics and a minor in physics are available.

EMU also offers a pre-engineering program. This program is designed for students who want to major in an engineering discipline but who also wish to spend a year or more at a Christian college to explore new meanings of faith and learning, to establish friendships, and to get a broader education than is typically provided by engineering schools.

Major in Mathematics

The following 48 SH program of courses is required:

MATH 170 Discrete Mathematics . . .	.4
MATH 185 Calculus I . . . . .	.4
MATH 195 Calculus II . . . . .	.4
MATH 240 Statistics for the Natural Sciences . . . . .	.3
MATH 285 Calculus III . . . . .	.4
*MATH 350 Linear Algebra . . . . .	.3
MATH 440 Mathematics Content Portfolio . . . . .	.1
*MATH 450 Introduction to Analysis	
OR	
*MATH 460 Abstract Algebra . . . . .	.3
CS major electives . . . . .	.6
PHYS 251 University Physics I . . . . .	.4

Careers in Mathematical Sciences include computer programmer/analyst, systems analyst, information system consultant, engineer, actuary, statistician, operations researcher, teacher and marketing research analyst.

Choose four of the following courses:

- *MATH 333 Topics in Math 3
- *MATH 340 Applied Mathematics . . . 3
- *MATH 360 Geometry 3
- *MATH 420 History of Math. 3
- *MATH 450 Introduction to Analysis **OR**
- *MATH 460 Abstract Algebra 3
- *MATH 470 Mathematical
Probability. 3

Major in Mathematics, Teaching Endorsement for Grades 6-12

This program will prepare students to teach mathematics by instructing them in the standards of the National Council of Teachers of Mathematics (NCTM). Students must complete the mathematics major as outlined above including MATH 360, MATH 420, and MATH 460. See page 89 for required courses for teacher licensure program, grades 6-12.

Major in Computer Science

Recognizing the wide range of topics covered by computing, EMU offers a program that allows students, together with the faculty advisor, to create a custom plan of study. The computer science major consists of 12 SH of foundational computer science courses covering programming, networking, computer architecture and system software, and database technologies; 18 SH of upper-level computer science courses; 9-11 SH of mathematics courses covering calculus through integration, topics in discrete mathematics, and basic statistical methods; and an additional 6 SH from computer science or related fields for a total of 45-47 SH. The specific 18 SH of upper-level computer science courses and the additional 6 SH of electives will be determined by student and advisor working together to tailor the program to the educational goals and career objectives of the student.

Students seeking a **bachelor of science degree in computer science** must include CS 320, CS 340, CS 420, MATH 170, MATH 185, and MATH 240 in their course selection and are encouraged to minor in mathematics. Students planning to seek a graduate degree in computer science should consider a double major in computer science and mathematics. Students who do not complete the math and computer science courses required for a B.S. will receive a **bachelor of arts degree in computer science**.

Foundational Courses (12 SH)

- CS 220 Intermediate Programming:
Java 3
- CS 230 Networking and Data
Communications. 3
- CS 250 Architecture and Operating
Systems 3
- CS 270 Databases and Information
Management 3

Upper-level Courses (18 SH)

Courses selected from the 300-level or 400-level CS courses.

Mathematics Courses (9-11 SH)

- MATH 130 Finite Mathematics **OR**
- MATH 170 Discrete Mathematics. . 3-4
- MATH 140 Elementary Statistics **OR**
- MATH 240 Statistics for the Natural
Sciences 3
- MATH 150 Elements of Calculus **OR**
- MATH 185 Calculus I. 3-4

Computer Science or Related Field Electives (6 SH with advisor approval)

Each student will choose additional courses based on a theme of study. The courses are selected with consultation and approval of a faculty advisor.

Major in Computer Science, Teaching Endorsement for Grades 6-12

Teaching endorsement in computer science (6-12) is approved by the Virginia Department of Education. Students must complete the computer science major as outlined above including CS 320, CS 340, CS 350, and CS 420. See page 89 for required courses for teacher licensure program, grades 6-12.

Pre-Engineering

The pre-engineering program provides a strong academic base for future study in engineering. Students studying pre-engineering at EMU should select an engineering school before the beginning of their second year in order to meet prerequisite requirements and to transfer the maximum number of semester hours.

Minor in Mathematics

The minor consists of 18 SH of mathematics including:

MATH 185 Calculus I. 4

MATH 170 Discrete Math 4

Choose an additional 10 SH selected from the remaining mathematics (MATH) courses listed in the major.

Minor in Computer Science

The minor consists of 18 SH of computer science courses of which at least 6 SH must be upper-level.

Minor in Physics

The physics minor consists of the following 17 SH program:

PHYS 251 University Physics I 4

PHYS 262 University Physics II. 4

Choose three courses from the following list:

*ENGR 270 Engineering Statics 3

*ENGR 280 Engineering Dynamics . . 3

*PHYS 160 Electronics 3

*PHYS 405 Thermodynamics 3

*PHYS 406 Quantum Mechanics 3

Computer Science (CS)

110 Introduction to Computer Science

3

A lab-based course designed to tour the modern world of computing. This course introduces the major areas of computer science, including data representation, computer hardware, programming languages, algorithms, operating systems, computer networks, and ethics in computing. This course is ideal both for general education purposes and for students considering a minor or major in computer science.

120 Introduction to Programming: Visual Basic

3

An introduction to the basic concepts of programming, problem-solving, and design techniques of an object-oriented, event-driven language.

220 Intermediate Programming: Java

3

An introduction to structured object-oriented programming techniques using the Java programming language. Students will write Java programs to implement a variety of algorithms for searching, sorting, and numerical computations. Input/output will use the console and graphical user interface components, text files, and image files. Prerequisite: CS 120 or other programming experience.

- 230 Networking and Data Communications** **3**
An introduction to networking and the Internet. Topics include TCP/IP and other network protocols, standard data formats, Web-based and general client/server applications, network infrastructure, and security.
- 250 Architecture and Operating Systems** **3**
An introduction to computer hardware and system software. Topics include digital logic, computer organization and architecture, interfacing and communication, memory management, scheduling and resource allocation, concurrency, and multiprocessor architectures.
- 270 Databases and Information Management** **3**
A course in software design in a database environment with an emphasis on the design and querying of database systems. Topics include design principles; loading, modifying, and querying databases; and macro programming. Prerequisite: CS 120 or equivalent.
- *320 Data Structures** **3**
Basic data structures are introduced in this course, including arrays, linked lists, stacks, queues, trees, etc. Simple algorithm analysis techniques will also be covered. Students are required to implement various data structures and algorithms using Java. Prerequisite: CS 220. (Fall 2012)
- 333 Topics in Computing** **3**
The department will offer at least one Topics course each year with the content based on the areas of interest of current students and faculty. The course may be taken for credit repeatedly since the content will vary from year to year. Topics may include: theory of computation, numerical analysis, modeling and simulation, graphics, computer animation, computer vision, advanced algorithmic analysis, cryptography, parallel algorithms, artificial intelligence, robotics, hypermedia development, language translation systems, and functional programming.
- *340 Analysis of Algorithms** **3**
An introduction to basic algorithm analysis and design techniques, including divide-and-conquer, greedy algorithm, and dynamic programming. Prerequisites: CS 320 and MATH 170. (Spring 2013)
- *350 System Administration** **3**
An overview of the management and maintenance of organizational computing infrastructure including hardware, operating system, network, database and application software. Topics include installation, configuration, routine maintenance tasks, client/server application management, automation, and user support. Prerequisite: CS 250. (Spring 2012)
- *370 Software Engineering** **3**
Software engineering is the set of interrelated disciplines that are utilized in the development, deployment, maintenance, and usage of enterprise-wide software solutions. This course focuses on the lifecycle of information systems and how that relates to strategic planning and information usage. Several software development lifecycle models will be explored as students participate in generating logical programming designs. Prerequisites: CS 220 and CS 270. (Spring 2012)

***420 Programming Languages** **3**

The formal study of programming language design and specification. Design principles are emphasized and evaluated in the context of the historical development of computing languages. Topics include design principles, study of actual languages, the run-time environment, translation, and programming in various programming languages and paradigms. Prerequisite: CS 320. (Fall 2011)

***470 Project Management** **3**

This course provides a comprehensive view of information systems. Topics include systems, management and organizations, information, quality, and decision-making processes. The relationship of information systems to corporate planning and strategy will also be explored. Prerequisite: CS 370. (Spring 2013)

488 Computer Science Internship **1-3**

Work experience gives students an opportunity to gain valuable practical experience. Consulting with the faculty advisor guides them in integrating theory and practice to maximize learning. Travel and other expenses are the student's responsibility. Internship opportunities are available through EMU's Washington Community Scholars' Center, organizations in the Harrisonburg area, and the EMU information systems department. Grading is on a pass/fail basis. Prerequisite: junior or senior status.

499 Independent Study/Research **1-3**

Individual study in an advanced topic in computer science. Requirements normally include the preparation of a research paper to be presented at a departmental seminar. Open to juniors and seniors. Prerequisite: faculty approval.

Mathematics (MATH)

101 Foundations of Math **1**

This course, which satisfies the EMU Mathematics Competency requirement, focuses on foundational mathematics necessary for the college graduate. Successful completion of the course requires demonstrating mastery in each of the following areas: computation and estimation; ratio, proportion, and measurement; geometry; decimals and percentages; data analysis. The course is offered in conjunction with tutorial support in the Academic Support Center. *The Math Competency requirement must be satisfied prior to taking other math courses.*

110 Modeling with Algebra **3**

This course will emphasize applied algebra through a modeling approach. Topics include equations and inequalities, polynomial and rational functions, exponential and logarithmic functions, and systems of equations and inequalities. A graphing calculator is required. A TI-83 or TI-84 is recommended. Prerequisite: MATH 101.

120 Mathematics and the Liberal Arts **2**

A survey of topics in contemporary mathematics. Topics may vary from year to year but will usually include geometry and trigonometry, apportionment and voting methods, consumer mathematics, and an introduction to computer programming. Prerequisite or corequisite: MATH 101.

130 Finite Mathematics **3**

A study of the strategies and tools of problem solving. Topics include set theory and logic, numeration systems (including a historical survey), number theory and the real number system, elementary graph theory, and basic probability and counting methods. Prerequisite: MATH 101.

- 140 Elementary Statistics** **3**
This general education course provides an introduction to descriptive and inferential statistics. Topics include correlation, normal distributions, confidence intervals, and hypothesis testing. A graphing calculator will be introduced and used throughout the course. *Credit will not be given for both this course and MATH 240.* Prerequisite: MATH 101.
- 145 Precalculus** **3**
This course is intended for students who need preparation for a calculus course. The focus will be on those aspects of algebra, functions (including exponential and logarithmic), trigonometry, and coordinate geometry that are needed for the study of calculus. Prerequisite: MATH 101 and MATH 110 or high school equivalent.
- 150 Elements of Calculus** **3**
A survey of the concepts of differential and integral calculus. This course emphasizes the applications of calculus to problems in business, economics and biology. A graphing calculator is required. Prerequisite: MATH 101 and a grade of C or better in MATH 145 or high school equivalent.
- 170 Discrete Mathematics** **4**
Discrete Mathematics serves as an introduction to advanced mathematics. In addition to learning material that is fundamental to mathematics and computer science, this course will emphasize logical thinking, problem-solving, and communication about abstract problems. Topics include set theory, number theory, logic, mathematical induction and other forms of proof, algorithms, combinatorics, recurrence relations, and graph theory. Prerequisites: MATH 101 and four years of high school mathematics.
- 185 Calculus I** **4**
A study of the fundamental concepts of the derivative of single-variable functions, including limits, continuity, differentiation techniques, and applications. The course also includes introductions to integration and to differential equations. A graphing calculator is required. Prerequisite: MATH 101 and a grade of B or better in MATH 145 or high school equivalent.
- 195 Calculus II** **4**
Topics include techniques and applications of integration of single-variable functions, infinite sequences and series, conics, parametric equations, and an introduction to vectors. A graphing calculator is required. Prerequisite: MATH 101 and a grade of C- or better in MATH 185, or permission of instructor.
- 240 Statistics for the Natural Sciences** **3**
This course in descriptive and inferential statistics is designed for students majoring in the mathematical and natural sciences. Probability distributions will be discussed in relation to confidence intervals and hypothesis testing. Correlation, regression, and analysis of variance will be covered as time permits. Students will apply statistical theory to a self-designed project. The spreadsheet program Excel will be introduced and used throughout the course. Prerequisite: MATH 150 or equivalent. *Credit will not be given for both this course and MATH 140.*
- 285 Calculus III** **4**
A study of vector-valued functions and functions of several variables. Topics include differentiation and integration of vector-valued functions, partial derivatives, multiple integration, line integrals, Green's theorem, the Divergence theorem, and Stokes theorem. Prerequisite: MATH 101 and a grade of C- or better in MATH 195, or permission of instructor.

- *333 Topics in Mathematics** **3**
 The content of this course is determined by the special interest of the faculty and students. Recent courses have included Number Theory, Coding Theory, Math Research, and Combinatorics. Prerequisite: permission of the instructor. (Fall 2011)
- *340 Applied Mathematics** **3**
 An introduction to mathematical modeling: problem identification, model construction, and model validation. The course includes a unit on differential equations as a technique for solving mathematical models. Prerequisite: MATH 195. (Spring 2013)
- *350 Linear Algebra** **3**
 Vectors and vector spaces, systems of linear equations, linear transformations and matrices, determinants, and eigenvalues and eigenvectors. Pre- or corequisites: MATH 170 and MATH 195 or permission of instructor. (Fall 2011)
- *360 Geometry** **3**
 A variety of mathematical methods (including the axiomatic method, the coordinate method, transformations, vectors, and trigonometry) are used to study Euclidean geometry. Hyperbolic, elliptic, and finite non-Euclidean geometries are also discussed. Prerequisite: MATH 170 (Fall 2012)
- *420 History of Mathematics** **3**
 The course will emphasize the men and women who have contributed to the historical development of mathematics. It will include the mathematics of early civilizations, Greek mathematics, non-western mathematics, the mathematics of the dark ages, the development of Calculus, and modern mathematics (probability, revival of number theory, set theory, philosophies of mathematics). Some contemporary mathematicians will be examined (Paul Erdos, Andrew Wiles, John Nash, and others) as time permits. Prerequisites: MATH 170, MATH 285, and either MATH 350 or MATH 360. (Spring 2012)
- 440 Mathematics Content Portfolio** **1**
 This independent-study style course is intended as a capstone for the mathematics major, to help the student make connections between the various courses taken as part of the major. The student will complete a portfolio containing five sections: Technology, Written Communication, Mathematical Connections, Major Field Test, and Reflection. The portfolio must include artifacts from each of the indicated categories, although the particular artifacts may vary. Prerequisite: senior math major standing.
- *450 Introduction to Analysis** **3**
 A critical study of the calculus. Topics include real numbers, sequences, limits, continuity, and differentiation and integration. Prerequisites: MATH 170 and MATH 195. (Spring 2013)
- *460 Abstract Algebra** **3**
 A study of the properties of groups, rings (including polynomial theory), and fields. The course builds on number theory encountered in MATH 170. Prerequisite: MATH 350. (Spring 2012)
- *470 Probability** **3**
 A study of probability, random variables, distribution and density functions, and the theory behind the statistical techniques used in MATH 240. Prerequisites: MATH 170, MATH 240, and MATH 285. (Fall 2012)

499 Independent Study

1-3

Individual study in an advanced topic in mathematics. Requirements normally include the preparation of a research paper to be presented at a departmental seminar. Open to juniors and seniors. Prerequisite: faculty approval.

Physics (PHYS)

* 160 Electronics

3

An introduction to basic analog and digital circuits. The analog portion includes DC and AC circuits, filters, transformers, and amplifiers. The digital portion covers binary numbers, combinational logic, various flip-flops, and registers. Some circuits, such as bicycle light flashers, DC power supply, and robots, will be built throughout the semester. The course is recommended for pre-engineering and computer science students and hobbyists. (Fall 2012)

251 University Physics I

4

A course with a laboratory that surveys the following topics in classical physics: mechanics, vibrations and waves, thermodynamics, and fluid mechanics. Elementary differential and integral calculus are used. Prerequisite: MATH 150 or MATH 185.

262 University Physics II

4

A continuation of PHYS 251. Topics include electricity, magnetism, optics, and modern physics (relativity; atomic, nuclear, and quantum physics) Prerequisite: PHYS 251.

* 405 Thermodynamics

3

A computation intensive foundational study of chemical thermodynamics and kinetics. Topics include gases, enthalpy, entropy, Gibbs free energy, chemical and phase equilibria, statistical thermodynamics, electrochemistry, and chemical kinetics. Three lectures per week. Prerequisite: MATH 150 or MATH 185. (CHEM 405) (Fall 2011)

* 406 Quantum Mechanics

3

A quantitative study of quantum mechanics as related to atomic and molecular structure, spectroscopy, statistical thermodynamics, solid state crystals and surfaces. Three lectures per week. Prerequisite: MATH 195. (CHEM 406) (Spring 2012)

Pre-Engineering (ENGR)

* 270 Engineering Statics

3

Principles of mechanics, vector treatment of force systems and friction, free body diagrams, moments, distributed forces, centroids, shear and moment in beams, moment of inertia, and applications. Prerequisites: MATH 185, PHYS 251. (Spring 2012)

* 280 Engineering Dynamics

3

Principles of vector mechanics as it relates to dynamical systems. Topics include kinematics, Newton's 2nd law, energy, momentum, rigid body motion, and mechanical vibrations. Prerequisites: MATH 185, PHYS 251. (Spring 2013)

**Indicates courses offered in alternate years.*