



Mathematical Sciences

Faculty:

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Majors:

- Mathematics
- Computer Science

Minors:

- Mathematics
- Computer Science
- Physics

Other program:

- Pre-engineering

Teaching Endorsements:

- Computer Science (add-on)
- Mathematics, Grades 6-12
- Physics, Grades 6-12 (add-on)

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 46 SH program of courses is required:

MATH 151 Differential Calculus . . .	3
MATH 162 Integral Calculus	3
MATH 171 Discrete Mathematics. . .	3
MATH 242 Statistics for the Natural Sciences	3
MATH 251 Intermediate Calculus . .	3
MATH 262 Multivariate Calculus. . .	3
*MATH 351 Linear Algebra	3
*MATH 452 Introduction to Analysis	
OR	
*MATH 462 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 361 Geometry 3
- *MATH 371 Topics in Math 3
- *MATH 382 Applied Mathematics 3
- *MATH 422 History of Math. 3
- *MATH 452 Introduction to Analysis **OR**
- *MATH 462 Abstract Algebra. 3
- *MATH 471 Mathematical Probability 3
- MATH 483 Summer Seminar 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 361 and MATH 422. See page 77 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 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 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 311, CS 322, CS 422, MATH 162, MATH 171 and MATH 242 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 212 Intermediate Programming:
 - Java 3
- CS 231 Networking and Data Communications 3
- CS 251 Architecture and Operating Systems 3
- CS 272 Databases and Information Management 3

Upper-level Courses (18 SH)

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

Mathematics Courses (9 SH)

- MATH 131 Elements of Calculus **OR**
- MATH 162 Integral Calculus 3
- MATH 141 Finite Mathematics **OR**
- MATH 171 Discrete Mathematics. 3
- MATH 201/2 Elementary Statistics **OR**
- MATH 242 Statistics for the Natural Sciences 3

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.

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 pre-requisite requirements and to transfer the maximum number of semester hours.

Minor in Mathematics

The minor consists of 18 SH of mathematics including:

MATH 151 Differential Calculus.3
MATH 162 Integral Calculus.3
and 12 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 I4
PHYS 262 University Physics II.4

Choose three courses from the following list:

*ENGR 262 Engineering Statics3
*ENGR 272 Engineering Dynamics. .3
*PHYS 241 Electronics3
*PHYS 401 Thermodynamics3
*PHYS 412 Quantum Mechanics . . .3

Add-on Teaching Endorsements

Teaching endorsements in computer science and physics (6-12) are approved by the Virginia Department of Education when combined with an education licensure.

Computer Science (CS)

101/2 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 web page design, data representation, computer hardware, programming languages, algorithms, operating systems, spreadsheets, 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. Some typing skill is recommended.

111 Introduction to Programming: Visual Basic 3

An introduction to the basic concepts of programming, problem-solving, as well as the design techniques of an object-oriented, event-driven language such as Visual Basic.NET.

212 Intermediate Programming: Java 3

Introduction to Java language in the context of media computation. Students will write Java programs to create and modify images, sounds, movie clips and web pages. Prerequisite: CS 111 or other programming experience.

231 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.

- 251 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.
- 272 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 111 or equivalent.
- *311 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 212.
- *322 Analysis of Algorithms** **3**
An introduction to basic algorithm analysis and design techniques, including divide-and-conquer, greedy algorithm and dynamic programming. Prerequisites: CS 311 and MATH 171.
- *352 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 and configuration, routine maintenance tasks, client/server application management, automation and user support. Prerequisite: CS 251.
- *371 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 corporate strategic planning and information usage. Several software development lifecycle models will be explored as students participate in generating logical programming designs. Prerequisites: CS 212 and CS 272.
- *422 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 Ada, Prolog and LISP. Prerequisite: CS 322.
- 452 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.

***472 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 371.

481/2/3 Computer Science Internship **1-3**
Work experience giving students an opportunity to integrate theory and practice. Consulting and reporting to the faculty advisor guide the student's experience in order to maximize learning. Travel and other expenses are the student's responsibility. Many students find the practical experience gained during internships to be extremely valuable. 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.

491/2/3 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)

101/2 Mathematics Competency **1**
This course 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; decimals and percentages; ratio and measurement; proportions; data analysis; geometry. The course is offered in conjunction with tutorial support in the Academic Support Center. *This requirement must be completed prior to taking other math courses.*

111/2 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 101/2.

122 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 measurement, apportionment and voting methods, consumer mathematics, and an introduction to computer programming. Prerequisite or corequisite: MATH 101/2.

131 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 (TI-83 or TI-84 recommended). Prerequisite: MATH 101/2 and MATH 111/2 or high school equivalent.

141 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 101/2.

- 151a Differential Calculus** **3**
An introduction to the derivative and associated topics in analytic geometry. Topics include functions (exponential, logarithmic, trigonometric, etc.), differentiation techniques, continuity and applications. Antiderivatives are introduced. A graphing calculator is required. A TI-83 or above is recommended. Prerequisite: MATH 101/2. Course may be taken concurrently with MATH 101/2 with instructor permission.
- 151b Differential Calculus with Review** **4**
This section of Differential Calculus includes review material of the algebra and trigonometry necessary for Differential and Integral Calculus. The main topics will be functions (trigonometric, exponential, rational, etc.) and their properties, unit circle trigonometry, special algebraic techniques, and summation notation. This section is recommended for students who have SAT math scores below 680. Prerequisite or co-requisite: MATH 101/2. Course may be taken concurrently with MATH 101/2 with instructor permission.
- 162 Integral Calculus** **3**
Concepts of the integral calculus are applied to elementary, exponential, logarithmic and trigonometric functions. Topics include techniques of integration and applications. A group project is a significant requirement for the course. Prerequisite: Grade of C- in MATH 151 or permission of instructor.
- 171 Discrete Mathematics** **3**
Topics include set theory, logic, mathematical induction, algorithms, combinatorics, probability, graph theory and proof writing. Prerequisites: MATH 101/2 and four years of high school mathematics.
- 201/2 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. The spreadsheet program Excel will be introduced and used throughout the course. *Credit for this course will not be given if the student has already received credit for MATH 242.*
- 242 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 131 or equivalent. *Credit for this course will not be given if the student has already received credit for MATH 201/2.*
- 251 Intermediate Calculus** **3**
Topics include sequences and series, improper integrals, polar coordinates, parametric equations, vectors, and vector-valued functions. Prerequisite: minimum grade of C- in MATH 162 or permission of instructor.
- 262 Multivariate Calculus** **3**
A study of functions of several variables, including partial derivatives, multiple integration, line integrals, Green's Theorem, the Divergence Theorem and Stokes Theorem. Prerequisite: minimum grade of C- in MATH 251 or permission of instructor.

- *351 Linear Algebra** **3**
 Vectors and vector spaces, systems of linear equations, linear transformations and matrices, determinants, and eigenvalues and eigenvectors. Prerequisite or corequisite: MATH 251 or permission of instructor. (Fall 2009)
- *361 Geometry** **3**
 A study of both Euclidean and non-Euclidean geometries using an axiomatic approach and taught from a historical perspective. Euclidean topics deal with transformations, convexity, the geometry of the polygon and circle, and constructions. Both hyperbolic and elliptic non-Euclidean geometries are discussed. Prerequisite: MATH 171 (Fall 2008)
- *371 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 2009)
- *382 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 162. (Spring 2009)
- *422 History of Math** **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 171, MATH 251, and either MATH 351 or MATH 361. (Spring 2010)
- *452 Introduction to Analysis** **3**
 A critical study of the calculus. Topics include real numbers, sequences, limits, continuity, and differentiation and integration. Prerequisite: MATH 251. (Spring 2009)
- *462 Abstract Algebra** **3**
 A study of the properties of groups, rings, integral domains and fields. Prerequisite: MATH 351. (Spring 2010)
- *471 Mathematical Probability** **3**
 A study of probability, random variables, distribution and density functions, and the theory behind the statistical techniques used in MATH 242. Prerequisites: MATH 242 and MATH 262. (Fall 2008)
- 483 Summer Seminar** **3**
 A special 3-week seminar determined by the faculty interest. Prerequisite: permission of the instructor.
- 491/2 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)

*241 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 2007)

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 131 or MATH 151.

262 University Physics II

4

A continuation of PHYS 251. Topics include electricity, magnetism, optics, relativity, and atomic and nuclear physics. Prerequisite: PHYS 251.

*401 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 131 or MATH 162. (CHEM 401) (Fall 2009)

*412 Quantum Mechanics

3

A quantitative study of quantum mechanics as related to atomic and molecular structure and spectroscopy. Three lectures per week. Prerequisite: MATH 162. (CHEM 412) (Spring 2010)

Pre-Engineering (ENGR)

*262 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, applications. Prerequisites: MATH 151, PHYS 251. (Spring 2009)

*272 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 151, PHYS 251. (Spring 2009)

**Indicates courses offered in alternate years.*