DEPARTMENT OF MATHEMATICAL, INFORMATION, AND COMPUTER SCIENCES

Mission Statement

The Mathematical, Information, and Computer Sciences department at Point Loma Nazarene University is committed to maintaining a curriculum that provides its students with the tools to be productive, the passion to continue learning, and Christian perspectives to provide a basis for making sound value judgments.

Purposes

1. To prepare students for:
   a. careers that use mathematics, data science, computer science, and information systems in business, industry, government and the non-profit sector.
   b. graduate study in fields related to mathematics, data science, computer science, and information systems.
   c. teaching mathematics and computer science at the secondary level.
2. To prepare students to apply their knowledge and utilize appropriate technology to solve problems.
3. To educate students to speak and write about their work with precision, clarity, and organization.
4. To help students gain an understanding of, and appreciation for, the historical development, contemporary progress, and societal role of mathematics, data science, information systems, and computer science.
5. To integrate the study of mathematics, data science, information systems, and computer science with the Christian liberal arts.

Tradition of Excellence

The Department of Mathematical, Information, and Computer Sciences features a highly skilled team of professors who share their wealth of knowledge with students both in and out of the classroom. The personal attention of the faculty and innovative learning environment help students to comprehend concepts in mathematics, information systems, and computer science. The accomplished faculty also conducts research with current students. Recently, topics have included random number generation, music and graph theory, statistics, stereo vision using genetic algorithms, artificial intelligence, biomathematics, and computer architecture. These types of research opportunities provide experience with modern technology and current real-world applications.

Career Opportunities

Students who graduate with a degree from the Department of Mathematical, Information, and Computer Sciences are prepared to succeed. Students have chosen careers in actuarial science, industrial engineering, information science, applied mathematics, statistics, data science, espionage, teaching, data analytics, software engineering, project management, and systems analysis.

Faculty

Chair - Maria Zack, Ph.D.

Catherine Crockett, Ph.D.
University of California, Riverside

Gregory Crow, Ph.D.
University of Notre Dame

Jesús Jiménez, Ph.D.
University of Utah

Michael Leih, Ph.D.
Claremont Graduate University

Benjamin Mood, Ph.D.
University of Florida, Gainesville

Carlson Triebold, Ph.D.
Purdue University

Maria Zack, Ph.D.
University of California, San Diego

To view requirements for majors, minors, and certificates, see the Degree Program Information (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/degree-program-information/) page.

- Computer Science: Cyber Security, B.S. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/computer-science-cyber-security-bs/)
- Computer Science: Software Engineering, B.A. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/computer-science-software-engineering-ba/)
- Computer Science: Software Engineering, B.S. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/computer-science-software-engineering-bs/)
- Computer Science: Technical Applications, B.S. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/computer-science-technical-applications-bs/)
- Data Science, B.S. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/data-science-bs/)
- General Engineering: Computer Science Engineering, B.S.E. (Mathematics and Computer Science) (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/general-engineering-computer-science-engineering-bse/)
- Information Systems (Mathematical, Information, and Computer Science), B.S. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/information-systems-bs/)
- Mathematics, B.A. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/mics/mathematics-ba/)
- Mathematics, B.A. for Associate Degree for Transfer (ADT) Students (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/

Computer Science

CSC 1011 Computer Programming for the Absolute Beginner (1 Unit)
A gentle introduction to computer programming/scripting in the Python language for those with no prior programming experience. Topics include the use/purpose of programming in the context of different academic disciplines along with the basics of writing code. Students will learn to write simple programs using input and output, conditional statements, loops, and graphics. This class is for anyone who wants to join the coding conversation or to gain a background for more rigorous programming courses.
Prerequisite(s): MTH 0099
Students who have credit for CSC 1043 may not take this course.

CSC 1043 Introduction to Computer Programming (2 Units)
Introduces the syntax of a high level programming language with emphasis on the programming environment and the use of the constructs of the language to write simple application programs. Topics include data types, sequential, conditional, and iterative statements, one and multi-dimensional arrays, simple graphical animation, the use of objects, and I/O. Programming assignments get progressively more complex and designed to demonstrate the use of computing in a variety of disciplines including the natural sciences.
Also offered as EGR 1043.
Prerequisite(s): MTH 1013 or equivalent.
Corequisite(s): CSC 1043L

CSC 1043L Introduction to Computer Programming Lab (1 Unit)
A lab course designed for a hands-on exploration of Introductory Computer Programming. Meets two hours per week.
Not repeatable. Letter grade.
Also offered as EGR 1043L.
Prerequisite(s): MTH 1013 or equivalent.
Corequisite(s): CSC 1043

CSC 1054 Objects and Elementary Data Structures (3 Units)
As a continuation of CSC 1043, this course deals with more advanced computing constructs and ideas, reinforced in weekly labs. Topics include object-oriented design, inheritance, polymorphism, exception handling, and recursion, along with more intentional development and debugging strategies. Linked lists are introduced as a viable option for implementing basic ADT's. Students gain experience in the design of graphical user interfaces, event driven programming, and larger programming projects.
Also offered as EGR 1054.
Prerequisite(s): CSC 1043 or EGR 1043 with a grade of C- or higher.
Corequisite(s): CSC 1054L

CSC 1054L Objects and Elementary Data Structures Lab (1 Unit)
A lab course designed for a hands-on exploration of Objects and Elementary Data Structures. Meets two hours per week.
Not repeatable. Letter grade.
Also offered as EGR 1054L.
Prerequisite(s): CSC 1043 or EGR 1043 with a grade of C- or higher.
Corequisite(s): CSC 1054

CSC 2052 Data Structures in C++ (1 Unit)
Students transition to the C++ language and are introduced to additional data structures, including queues, stacks, trees, and graphs considering their implementation with both arrays and linked lists. Concepts are reinforced through weekly programming assignments.
Prerequisite(s): CSC 1054 or EGR 1054 with a grade of C- or higher.
Corequisite(s): CSC 2052L
CSC 2052 is the first quad of CSC 2054.

CSC 2052L Data Structures in C++ Lab (1 Unit)
A lab course designed for a hands-on exploration of Data Structures in C++. Meets two hours per week.
Not repeatable. Letter grade.
Prerequisite(s): CSC 1054 or EGR 1054 with a grade of C- or higher.
Corequisite(s): CSC 2052

CSC 2054 Data Structures and Algorithms (3 Units)
Standard data structures, including queues, stacks, trees, and graphs, as objects are defined and illustrated with associated dynamic storage management mechanisms. Introduces formal techniques to support the design and analysis of algorithms, focusing on both the underlying mathematical theory and practical considerations of efficiency. Topics include measuring the complexity of recursive and iterative algorithms, algorithmic strategies, the concept of intractability and the theory of NP. Emphasis is placed on non-numerical algorithms such as sorting, searching, graph and network algorithms both sequential and parallel. Concepts are reinforced through weekly programming assignments.
Prerequisite(s): CSC 1054 or EGR 1054 with a grade of C- or higher.
Corequisite(s): CSC 2054L

CSC 2054L Data Structures and Algorithms Lab (1 Unit)
A lab course designed for a hands-on exploration of Data Structures and Algorithms. Meets two hours per week.
Not repeatable. Letter grade.
Prerequisite(s): CSC 1054 or EGR 1054 with a grade of C- or higher.
Corequisite(s): CSC 2054

CSC 3002 UNIX and Python Scripting for Computational Science (2 Units)
An introduction to UNIX and Python scripting in the context of applications to scientific research. Students will become competent users of the UNIX operating system. They will learn to find and manipulate data from various file formats (including text, FASTA, HTML, XML) using regular expressions with UNIX and Python scripts. They will learn to use Python for data analysis and for more specialized purposes using third party modules including NumPy, BioPython, and Tkinter.
Prerequisite(s): CSC 1043 or EGR 1043 with a grade of C- or higher.

CSC 3011 Machine Learning and Multivariate Modeling in R (1 Unit)
Students will learn the fundamentals of modeling complex multivariate data, using both foundational regression and logistic regression techniques, as well as the basics of supervised and unsupervised machine learning approaches. Additionally, students will learn to assess model fit and how to select appropriate modeling tools to identify relationships in complex data sets. Along with hands on instruction, students will work on real applications from industrial applications in business and science.
Prerequisite(s): CSC 1043 or EGR 1043 with a grade of C- or higher.

CSC 3012 Operating Systems for Software Engineering Certificate (2 Units)
A systems course focusing on structural design and services of operating systems, along with the use of both GUI and command-line interfaces. Special attention is paid to process management and concurrency.
Prerequisite(s): CSC 2052 or CSC 2054

CSC 3014 Operating Systems (4 Units)
A systems course focusing on operating systems, topics include basic operating system design, process management, device management, memory management, and file systems. Students are introduced to the basics of software evolution, reliability, concurrency, security and protection in the context of single-core, multi-core, distributed, and virtual environments. Class members gain experience using both GUI and command-line interfaces. In the course of implementing the CPU scheduling simulation, students understand the importance of thorough system testing and attention to system specs as they try to make parts of their systems work with those designed by their teammates.
Also offered as EGR 3014.
Prerequisite(s): CSC 2052 or CSC 2054

CSC 3021 Computational Tools (1 Unit)
A brief introduction to a variety of computing tools for students already competent in computer programming. Students will gain experience in using Excel with VBA, Visual Basic, Microsoft Access, HTML and JavaScript. The goal of this course is to help expand student awareness of available computing tools and the strengths and weaknesses of each.
Prerequisite(s): CSC 3002 or consent of instructor.
CSC 3021 is the first quad of CSC 3022.

CSC 3022 Data Management for Computational Science (2 Units)
An introduction to data management in the context of scientific research and business applications. Students will explore the data storage and manipulation requirements for these areas and learn to choose the correct data management tool for a given situation. Tools include Microsoft Excel (with VBA), Visual Basic, Microsoft Access, and HTML. Students will learn to design, create, and query relational databases using Database Management System and SQL query language.
Prerequisite(s): CSC 3002 or consent of instructor.

CSC 3023 Software Engineering (3 Units)
This course offers an in-depth treatment of the software development process. Software analysis and design study emphasizes an object-oriented approach that is introduced and contrasted with traditional design methodologies. CASE tools are used during the design process.
Corequisite(s): CSC 2054

CSC 3031 Data Visualization and Communication with R (1 Unit)
Students will learn to create effective static and dynamic graphics for representing complex data sets. Students will learn to apply the principles of effective storytelling with data, and best practices in data design and communication.
Also offered as EGR 3023.
Prerequisite(s): CSC 1043 or EGR 1043 with a grade of C- or higher.

CSC 3054 Design and Analysis of Algorithms (4 Units)
Introduces formal techniques to support the design and analysis of algorithms, focusing on both the underlying mathematical theory and practical considerations of efficiency. Topics include measuring the complexity of recursive and iterative algorithms, algorithmic strategies, the concept of intractability and the theory of NP. Emphasis is placed on non-numerical algorithms such as sorting, searching, and graph and network algorithms both sequential and parallel.
Prerequisite(s): CSC 2054 and MTH 3043

CSC 3094 Programming Languages (4 Units)
This course in programming languages covers language design issues and language translators. Laboratories give students a practical understanding of programming language concepts as well as give experience in programming using several programming languages.
Prerequisite(s): CSC 2054 and MTH 3043

CSC 3102 Security+ Exam Preparation (1-2 Units)
This is an independent study course designed for students who wish to prepare for the CompTIA's Security+ certification exam. The course is intended for students who have already completed at least one course in computer security.
Prerequisite(s): Consent of instructor.

CSC 3112 Network+ Exam Preparation (1-2 Units)
This is an independent study course designed for students who wish to prepare for the CompTIA's Network+ certification exam. The course is intended for students who have already completed at least one course in computer networking.
Prerequisite(s): Consent of instructor.

CSC 4012 Topics in Computer Science (2 Units)
Study of an area of computer science not otherwise included in the curriculum. Topics are determined by the needs and interest of the students and faculty involved.
May be repeated up to a total of six (6) units.
Prerequisite(s): CSC 2054, MTH 1031 and MTH 1044 or MTH 1064 and consent of instructor.

CSC 4054 Computer Architecture and Assembly Language (4 Units)
This course covers the fundamentals of current pipelined computer designs. Experience with assembly language programming and digital logic and circuit design will be used to motivate the need for certain facets of the more general instruction set architecture. Throughout the course, performance issues, hardware constraints, and memory hierarchy will be shown to inform processor design. Additional topics include integer and floating point arithmetic, I/O and considerations surrounding multi-core architectures.
Also offered as EGR 4054.
Prerequisite(s): CSC 1054 or EGR 1054 with a grade of C- or higher and Junior or Senior standing.

CSC 4081 Senior Seminar in Computer Science (1 Unit)
This one-unit capstone course is a seminar in which students give lectures on topics of general interest in computer science. Issues related to vocation and calling are also discussed.
Credit/No Credit.
Prerequisite(s): One of CSC 4102, CSC 4133, HON 4098, ISS 4072, ISS 4102, ISS 4133, MTH 4102, or MTH 4133 and Senior standing (or Junior standing if a December graduate).

CSC 4091 Independent Studies in Computer Science (1-4 Units)
Study of a selected problem or topic under the direction of an instructor. The instructor and student propose the course of study.
May be repeated for a total of six (6) units.
Prerequisite(s): Consent of instructor and approval by the department chair is required.

CSC 4093 Software Project (3 Units)
This course presents the student with a strong experience in software engineering. Students, working in teams, investigate, design, implement and present to their classmates a significant software project. The project should solve a significant, complex and generalizable problem, dealing with constraints and trade-offs in the solution. The course includes study of project management concerns such as planning, scheduling, and assessing progress.
Prerequisite(s): CSC 3023 and Junior or Senior standing.

CSC 4102 Independent Research in Computer Science I (2 Units)
Independent research conducted under the guidance of a faculty mentor. The instructor and student propose the research topic.
Credit/No Credit.
Prerequisite(s): Approval of the department chair, consent of instructor, and Junior standing.

CSC 4121 Independent Research in Computer Science II (1 Unit)
The continuation of independent research conducted under the guidance of a faculty mentor. The instructor and student propose the research topic.
Credit/No Credit.
Prerequisite(s): Approval of the department chair, CSC 4102, and consent of instructor.

CSC 4133 Service Learning in Computer Science (3 Units)
Students working in teams design and implement a project using a broad spectrum of computer science knowledge to meet the needs of a community organization or the university.
Prerequisite(s): Consent of instructor and Junior standing.

Information Systems

ISS 3042 Project Management and Quality Assurance (2 Units)
This course discusses the processes, methods, techniques and tools that organizations use to manage their information systems and software development projects. This course covers a systematic methodology for initiating, planning, executing, controlling, and closing projects. It also looks at techniques including unit testing for quality assurance.
Prerequisite(s): CSC 1054 with a grade of C- or higher.

ISS 3073 Networking and Security (3 Units)
This course provides an introduction to modern computer network technologies. Students gain an understanding of networking fundamentals including layering and the old OSI model, protocols, standards, and network services. LANS, MANS, WANS, Internet and wireless networks are covered. The class will also cover the basics of network security. The class includes hands-on activities.
Prerequisite(s): CSC 1054 with a grade of C- or higher and Junior standing.

ISS 3092 Topics in Cyber Security (2 Units)
Study of an area of computer security otherwise included in the curriculum. Topics are determined by the needs and interest of the students and faculty involved.
May be repeated up to a total of four (4) units.
Prerequisite(s): CSC 3014 or consent of instructor.

ISS 4003 Information and Computer Security (3 Units)
This course provides an overview of modern topics in information and computer security, including: network security, web security, compliance and operational security, threats and vulnerabilities, privacy and anonymity, application, data and host security, access control and identity management, cryptography. This class includes theoretical analysis and hands-on activities.
Prerequisite(s): CSC 3014 and ISS 3073

ISS 4012 Topics in Information Security (2 Units)
Study of an area of information security otherwise included in the curriculum. Topics are determined by the needs and interest of the students and faculty involved.
May be repeated up to a total of four (4) units.
Prerequisite(s): CSC 3014 or consent of instructor.

ISS 4014 Data Base Systems and Web Integration (4 Units)
An introduction to database management systems covering data models (including relational, network, hierarchical, and object oriented), relational databases, query languages, relational database design, transaction processing, distributed databases, and physical database design. Students will see examples from both business and science. They will become familiar with analysis tools and gain experience accessing databases using Python scripts and web-based gateways. Students will also design web interfaces for data bases.
Prerequisite(s): CSC 1054 with a grade of C- or higher.

ISS 4072 Internship in Information Systems (2 Units)
A supervised experience in which the student works with industry professionals to gain experience with managing information systems. May be repeated for a total of four (4) units. Credit/No Credit.
Prerequisite(s): Student must have taken at least two upper-division computer science or information systems courses for their major and consent of instructor.
"C" Designation is for California Internships. "E" Designation is for Out of State Internships.

ISS 4081 Senior Seminar in Information Systems (1 Unit)
This one-unit capstone course is a seminar in which students give lectures on topics of general interest in Information Systems. Issues related to vocation and calling are also discussed.
Credit/No Credit.
Prerequisite(s): One of CSC 4102, CSC 4133, HON 4098, ISS 4072, ISS 4102, ISS 4133, MTH 4102, or MTH 4133 and Senior standing (or Junior standing if a December graduate).

ISS 4102 Independent Research in Information Systems I (2 Units)
Independent research conducted under the guidance of a faculty mentor. The instructor and student propose the research topic.
Credit/No Credit.
Prerequisite(s): Approval of the department chair, consent of instructor, and Junior standing.

ISS 4121 Independent Research in Information Systems II (1 Unit)
The continuation of independent research conducted under the guidance of a faculty mentor. The instructor and student propose the research topic.
Credit/No Credit.
Prerequisite(s): ISS 4102, approval of the department chair, and consent of instructor.

ISS 4133 Service Learning in Computer Information Systems (3 Units)
Students working in teams design and implement a project using a broad spectrum of information systems knowledge to meet the needs of a community organization or the university.
Prerequisite(s): Consent of instructor and Junior standing.

Mathematics

MTH 0099 Elementary Algebra (3 Units)
An introduction to algebra, including a study of the real number system, solutions of linear and quadratic equations, polynomials, factoring, systems of equations, graphing, inequalities, and radicals.
This course does not count toward the minimum 128 units required for graduation.

MTH 1013 College Algebra (3 Units)
A review and extension of elementary algebra, solutions of linear and quadratic equations, radicals, inequalities, linear and quadratic functions, polynomial functions, exponential and logarithmic functions, conic sections, sequences and series and graphing.
Prerequisite(s): MTH 0099 or equivalent.

MTH 1021 Calculus and Modeling (1 Unit)
An introduction to mathematical modeling using mathematical concepts from Calculus I.
Credit/No Credit.
Prerequisite(s): A score of 3 or more on AP 114 or AP 115 or credit for a calculus course from another institution.

MTH 1031 Computer Aided Calculus (1 Unit)
Introduction to the use of a computer algebra system to complement the knowledge of calculus.
Prerequisite(s): MTH 1044 or a score of 3 or higher on AP 114 or AP 115.

MTH 1033 Pre-Calculus (3 Units)
An introduction to the functions necessary for the study of calculus with an emphasis on numericals and graphical notions of continuity, limits and derivatives. The following function types are used as examples for the study of the concepts: polynomial, rational, exponential, logarithmic, and trigonometric functions.
Prerequisite(s): MTH 1013 or equivalent.

MTH 1044 Calculus with Applications (FE) (4 Units)
Differential and integral calculus of the elementary functions of one variable. Limits, continuity, derivatives, integrals, and applications.
Prerequisite(s): MTH 1033 or equivalent.

MTH 1053 Mathematical Analysis for Business and Economics (3 Units)
This course focuses on learning and using basic mathematical tools that are fundamental to business applications. Applications of these tools include: supply and demand, optimization, cost-benefit analysis, equilibrium (systems of equations), interest, and loan amortization.
Prerequisite(s): MTH 1013 or equivalent.

MTH 1064 Calculus I (FE) (3 Units)
Calculus of the elementary functions of one variable. Limits, continuity, derivatives, methods of integration and applications.
Prerequisite(s): MTH 1033 or equivalent.
Corequisite(s): MTH 1064L

MTH 1064L Calculus I Lab (FE) (1 Unit)
An introduction to mathematical modeling using mathematical concepts from Calculus I.
Corequisite(s): MTH 1064

MTH 1073 Business Calculus (FE) (3 Units)
A calculus course intended for those studying business economics, or other related business majors. This course covers differential and integral calculus of elementary functions with an emphasis on business applications. This is a brief calculus course and not appropriate for students majoring in science, computer science or mathematics.
Prerequisite(s): MTH 1013 or equivalent.

MTH 1074 Calculus II (3 Units)
A continuation of Calculus I supported by the use of computer graphics and a symbolic computer algebra system. Methods of integration, sequences, series, elementary differential equations, polar coordinates and parametric equations.
Prerequisite(s): MTH 1044 with a grade of C- or higher or MTH 1064 with a grade of C- or higher.
Corequisite(s): MTH 1074L

MTH 1074L Calculus II Lab (1 Unit)
Introduction to the use of a computer algebra system to complement the knowledge of calculus.
Corequisite(s): MTH 1074

MTH 2003 Introduction to Statistics (3 Units)
A first course in statistics for the general student. Description of sample data, probability theory, theoretical frequency distributions, sampling, estimation, and hypothesis testing.
Not applicable toward a major in Mathematics.
Prerequisite(s): MTH 0099 or equivalent.

MTH 2013 Fundamentals of Elementary Mathematics I (3 Units)
A comprehensive approach to the mathematical knowledge necessary for a California multiple subject teaching credential (K-8). Topics covered in this course include whole numbers, numeration systems, fractions, decimals, ratios, proportions and an introduction to number theory. The integers, rational numbers, irrational numbers and real numbers are studied along with algebraic expressions, inequalities, graphs and polynomials. This class is highly interactive and emphasizes group work and cooperative learning.
Not applicable toward a major in Mathematics. Passing an 8th grade mathematics proficiency test is a requirement for the completion of this course.
Prerequisite(s): MTH 1013 or equivalent.

MTH 2023 Fundamentals of Elementary Mathematics II (3 Units)
A continuation of Mathematics 213 focusing on additional knowledge necessary for a California multiple-subject teaching credential (K-8). Topics covered in this course include data analysis and statistics, probability, combinations and permutations, simulations as well as standard and non-standard measurement. Planar and three dimensional geometry and geometric constructions are studied, including an algebraic approach to geometry. This class is highly interactive and emphasizes group work and cooperative learning.
Prerequisite(s): MTH 2013

MTH 2033 Linear Algebra (3 Units)
A computational introduction to linear algebra with applications. A study of linear equations, matrix algebra, Euclidean spaces and subspaces, vector spaces, linear transformations, eigenvalues, eigenvectors, and inner products.
Prerequisite(s): MTH 1044 with a grade of C- or higher or MTH 1064 with a grade of C- or higher.

MTH 2074 Calculus III (4 Units)
Conceptual development of the calculus of functions of more than one variable supported by the use of a symbolic computer algebra system. Limits and continuity, partial derivatives, chain rule, extreme values, Taylor's theorem, multiple integrals, line and surface integrals, Green's Theorem and Stokes' Theorem.
Prerequisite(s): MTH 1074 with a grade of C- or higher.

MTH 2092 Applied Project for Data Science (2 Units)
This course introduces students to the complete data science process. Students will work in teams to scope a real-world problem, gather data to answer the question, wrangle the data, model it, validate the models, draw conclusions and communicate results. The course includes study of the principles of data science and technical communication. This course will integrate prior cross-disciplinary coursework and introduce students to the basics of scripting and integrating tools into full-stack solutions.
Prerequisite(s): MTH 2074 with a grade of C- or higher.

MTH 3003 Problem Solving (FE) (3 Units)
A Foundational Explorations course whose major goal is to develop the ability to solve non-routine problems through dynamic processes of inquiry and exploration, logical reasoning, making and testing conjectures and investigating implications of conclusions. A study of quantitative reasoning with emphasis on active problem solving and developing connections with other disciplines.
Not applicable toward a major in Mathematics.
Prerequisite(s): MTH 0099 or equivalent and Junior or Senior standing.

MTH 3012 Number Theory with Proofs (2 Units)
An introduction to proofs using the study of natural numbers, integers, prime factorization, divisibility, congruences, multiplicative functions, continued fractions, quadratic residues. Methods used include investigation, conjecture, inductive and deductive proofs.
Prerequisite(s): MTH 1074 with a grade of C- or higher.

MTH 3033 Differential Equations (3 Units)
Ordinary differential equations, solutions by analytical and numerical methods in the context of real world applications. A brief introduction to partial differential equations and Fourier series.
Prerequisite(s): MTH 2074 with a grade of C- or higher.

MTH 3043 Discrete Mathematics (3 Units)
Sets, functions, propositional logic and switching theory, graphs including trees, matrices, induction and proof by contradiction, combinatorics, and probability. Selected applications from computer science included.
Prerequisite(s): MTH 1044 with a grade of C- or higher or MTH 1064 with a grade of C- or higher.

MTH 3052 History of Mathematics (2 Units)
Development of mathematics from pre-Greek to recent times. Perspectives and contributions of persons from diverse cultural, ethnic, and gender groups. Impact of culture on mathematical progress.
Prerequisite(s): MTH 1044 with a grade of C- or higher or MTH 1064 with a grade of C- or higher.

MTH 3063 Calculus Based Statistics with R (3 Units)
A first course in descriptive and inferential statistics for general students who have taken calculus. Topics include experimental design, sampling and sampling distributions, estimation and hypothesis testing. This course also provides a basic introduction to statistical analysis in the statistical software package R.
Not applicable toward a major in Mathematics.
Prerequisite(s): MTH 1044 with a grade of C- or higher or MTH 1064 with a grade of C- or higher or equivalent.

MTH 3073 Mathematical Modeling (3 Units)
A problem based course that explores mathematical modeling techniques using a variety of computational methods. Also examines how mathematics can be applied to answer specific questions. Includes problems from biology, chemistry, physics, business and other non-mathematical disciplines. Written report and oral presentation are required.
Prerequisite(s): MTH 2074 and MTH 3083

MTH 3083 Mathematical Probability and Statistics (3 Units)
A first course in probability and statistics for students with sophisticated mathematics exposure. Topics include axioms of probability, random variables, discrete and continuous distributions, mathematical expectation, and limit theorems. Introduction into descriptive and inferential statistics, including the topics of sampling distributions, point estimation and hypothesis testing. Topics are supported by the use of statistical software.
Prerequisite(s): MTH 2074 with a grade of C- or higher.

MTH 4002 Topics in Geometry (2 Units)
A study of the foundations of geometry, Affine, non-Euclidean and projective geometries. A synthetic development of advanced Euclidean geometry including geometric transformations, convexity, and constructions.
Prerequisite(s): MTH 1044 or MTH 1064

MTH 4013 Complex Analysis (3 Units)
Complex numbers, analytic functions, integration, series, contour integration, residues and conformal maps.
Corequisite(s): MTH 2074

MTH 4024 Real Analysis (4 Units)
Real numbers, topology of Euclidean n-space, continuity, differentiation and integration theory.
Corequisite(s): MTH 2033 and MTH 3012 and Junior standing.

MTH 4044 Abstract Algebra (4 Units)
A study of groups, rings, fields and related structures with selected applications.
Corequisite(s): MTH 2033 and MTH 3012 and Junior standing.

MTH 4053 Advanced Applied Statistics (3 Units)
This course is a continuation of MTH 3083 including the topics of random sampling and experimental design, sampling distributions, methods of estimation and the properties of estimators, least square estimates of parameter, linear regression, hypothesis testing, and confidence intervals, testing of models, data analysis and appropriateness of models. Topics are supported by the use of statistical software.
Prerequisite(s): MTH 3083

MTH 4062 Research in Data Science (2 Units)
Independent research conducted under the guidance of a faculty mentor. The instructor and student propose the research topic.
Credit/No Credit.
Prerequisite(s): MTH 2092, MTH 3083, approval of the department chair, consent of instructor, and Junior standing.

MTH 4071 History of Mathematics Study Tour (1 Unit)
This course is conducted as a European trip (countries vary). The course uses specific museums, library collections and historic sites to investigate the development of mathematics in relation to specific problems.
Lectures and meeting are held during the semester and a series of lectures by the professor and others are presented on location.
Prerequisite(s): Consent of instructor.

MTH 4072 Internship in Data Science (2 Units)
A supervised experience in which the student works with industry professionals to gain experience in data science.
May be repeated up to a total of four (4) units. Credit/No Credit.
Prerequisite(s): MTH 2092, MTH 3083, and consent of instructor.
"C" Designation is for California Internships. "E" Designation is for Out of State Internships.

MTH 4081 Senior Seminar in Computer Science (1 Unit)
This one-unit capstone course is a seminar in which students give lectures on topics of general interest in mathematics. Issues related to vocation and calling are also discussed.
Credit/No Credit.
Prerequisite(s): One of CSC 4102, CSC 4133, HON 4098, ISS 4072, ISS 4102, ISS 4133, MTH 4102, or MTH 4133 and Senior standing (or Junior standing if a December graduate).

MTH 4091 Independent Study in Mathematics (1-4 Units)
Study of a selected problem or topic under the direction of an instructor. The instructor and student propose the course of study. Approval by the department chair is required.
May be repeated up to a total of six (6) units.
Prerequisite(s): Consent of instructor.

MTH 4092 Special Topics in Mathematics (2 Units)
Study of an area of mathematics not otherwise included in the curriculum. The needs and interests of students and faculty involved determine the topics.
May be repeated up to a total of six (6) units.
Prerequisite(s): Consent of instructor.

MTH 4102 Independent Research in Mathematics I (2 Units)
Independent research conducted under the guidance of a faculty mentor. The instructor and student propose the research topic.
Credit/No Credit.
Prerequisite(s): Approval of the department chair, consent of instructor, and Junior standing.

MTH 4121 Independent Research in Mathematics II (1 Unit)
The continuation of independent research conducted under the guidance of a faculty mentor. The instructor and student propose the research topic.
Credit/No Credit.
Prerequisite(s): MTH 4102, approval of the department chair, and consent of instructor.

MTH 4133 Service Learning in Mathematics (3 Units)
Students working in teams design and implement a project using a broad spectrum of mathematical knowledge to meet the needs of a community organization or the university.
Prerequisite(s): Consent of instructor and Junior standing.

Physics

PHY 4082 Senior Project II (2 Units)
This course provides students (teams) with the opportunity to hone and finish building the project design initiated in PHY 4072. The students will prepare a scientific paper about their research/project and give an oral presentation of their findings. This course will normally be completed in a student's senior year.
Prerequisite(s): PHY 4072 or consent of instructor.