B.S. IN MATHEMATICS AND DATA SCIENCE

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MAT 124M</td>
<td>Calculus 1</td>
<td>4</td>
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<tr>
<td>MAT 125</td>
<td>Calculus 2</td>
<td>4</td>
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<tr>
<td>MAT 211</td>
<td>Linear Algebra</td>
<td>3</td>
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<td>MAT 222</td>
<td>Differential Equations</td>
<td>3</td>
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<td>MAT 223</td>
<td>Multivariable Calculus</td>
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<td>MAT 241</td>
<td>Discrete Mathematics</td>
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<td>MAT 310</td>
<td>Algebraic Structures</td>
<td>4</td>
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<td>MAT 330</td>
<td>Probability and Statistics</td>
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<td>MAT 331</td>
<td>Applied Statistics</td>
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<td>MAT 344</td>
<td>Numerical Methods</td>
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<td>MAT 376</td>
<td>Operations Research</td>
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<td>MAT 422</td>
<td>Real Analysis</td>
<td>3</td>
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<td>MAT 499</td>
<td>Foundations of Mathematics</td>
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Required Courses in Computer Science:

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<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>COS 100</td>
<td>Introduction to Programming</td>
<td>3</td>
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<tr>
<td>COS 205</td>
<td>Scientific Computing</td>
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<tr>
<td>COS 105</td>
<td>Computer Science 1</td>
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<tr>
<td>COS 212</td>
<td>Computer Science 2</td>
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<tr>
<td>COS 216</td>
<td>Data Structures and Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>COS 313</td>
<td>Database Systems</td>
<td>3</td>
</tr>
<tr>
<td>COS 334</td>
<td>Data Mining and Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td>BUS 317</td>
<td>Business Analytics</td>
<td>4</td>
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<tr>
<td>ECO 340</td>
<td>Econometrics</td>
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Choose a course in Business:

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<tr>
<td>BUS 317</td>
<td>Business Analytics</td>
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<tr>
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<td>Econometrics</td>
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With the addition of a 200-level or above Computer Science course, requirements for a minor in Computer Science would be fulfilled. With the addition of COS 214 Computer Architecture, COS 301 Operating Systems and a choice of courses (6 credits) from COS 313 Database Systems, COS 318 Web Programming, COS 386 Data Communications and Computer Networks, COS 420 Software Process, and COS 477 Software Engineering requirements for a B.A. in Computer Science would be fulfilled.

Courses whose number is followed by a letter fulfill a General Education requirement.

COS 100 • Introduction to Programming 3 Credits.
An introduction to programming using a current procedural (imperative) programming language. Standard data types and control structures are introduced.

Offered: Fall, Interim.

COS 105 • Computer Science 1 4 Credits.
Introduction to fundamental search and sort algorithms, analysis, design methodologies, and object-oriented programming. Strong emphasis on theory. Extensive programming assignments in a current object-oriented computer language.
Prerequisites: COS 100, COS 205, or equivalent proficiency; MAT 123M, MAT 124M, MAT 125, or equivalent proficiency. Offered: Spring.
Special Notes: Not designed as a computer literacy course. Includes 6 lab hours.

COS 205 • Scientific Computing 3 Credits.
Introduction to programming in C and C++ with an emphasis on issues relevant to scientific computing such as machine error, performance, and implementation of common numerical algorithms.
Prerequisites: MAT 124M. Offered: Fall, Spring.

COS 212 • Computer Science 2 4 Credits.
Elementary data structures such as file structures, linked lists, and simple trees. Extensive programming assignments in a current computer language.
Prerequisites: COS 105 or COS 205 with consent of instructor. Special Notes: Includes 6 lab hours. Offered: Fall.

COS 214 • Computer Architecture 4 Credits.
Assembly and machine language to study computer organization and structure, including addressing techniques, digital logic and representation of numbers and arithmetic. Also includes an introduction to C.
Prerequisites: COS 212. Offered: Spring.

COS 216 • Data Structures and Algorithms 3 Credits.
Advanced data structures, algorithms, and algorithm analysis. Extensive programming assignments in a current object-oriented computer language.
Prerequisites: COS 212. Offered: Spring.

COS 301 • Operating Systems 4 Credits.
Computer organization, structure of operating systems, memory management, process management, resource allocation, and operating system monitors. Alternative approaches to operating system design.
Prerequisites: COS 214; knowledge of C or C++. Offered: Fall.

COS 313 • Database Systems 3 Credits.
Relational and object-oriented databases, schemas, and normalization. Database management systems, SQL, concurrent transactions, logging/disaster recovery, and query optimization. Application program interaction with database management systems.
Prerequisites: COS 216. Offered: Fall, even # years.

COS 318 • Web Programming 3 Credits.
An examination of the foundational technologies used for creating web applications. Includes client and server programming, as well as fundamentals of cloud services, including security, storage, and reliability.
Prerequisites: COS 216. Special Notes: Some knowledge of HTML and the basics of JavaScript are expected. Offered: Fall.

COS 320 • Computer Graphics Programming 3 Credits.
An introduction to the drawing methods, geometrical transforms, and illumination models that are fundamental to computer graphics programming. Topics include modeling of 2D and 3D objects, local and global illumination simulation, shading, color models, procedural modeling, and discrete (fragment) techniques including texture mapping. A current graphics API is used, including custom shaders.
Prerequisites: COS 216. Offered: Fall, odd # years.

COS 334 • Data Mining and Machine Learning 3 Credits.
An introduction to widely-used techniques for extracting information from large data sets such as medical databases, credit reports, weather history, and the stock market. Includes algorithms for nominal and ordinal data and metrics to measure their performance. Students will implement common algorithms with real data and choose appropriate algorithms for different applications.
Prerequisites: COS 216. Offered: Spring, even # years.

COS 337K • Behavioral Robotics 3 Credits.
Control and automation are fundamental aspects of human, animal, and machine behavior. These topics will be considered from philosophical and psychological perspectives and explored through robotics and other hands-on experimental labs, in order to develop both a practical and theoretical understanding of behavior.
Prerequisites: Laboratory Science (D) course; Mathematics (M) course. Special Note: Carries cross credit in psychology. Offered: Interim.

COS 351 • High-Performance Computing 3 Credits.
Fundamental concepts and techniques for parallel computation in C/C++ (load balancing, communication, synchronization, serial program decomposition) using an industry-standard parallel computing library.
Prerequisites: COS 205, COS 214. Offered: Interim.

COS 371 • Organization of Programming Languages 3 Credits.
Formal programming language specification using various grammars and the Backus-Naur Form. Data types and structures, control structures, and data flow of several programming languages, including interpreters and compilers. Introduction to parsing and lexical analysis.
Prerequisites: COS 216. Offered: Spring, even # years.

COS 386 • Data Communications and Computer Networks 3 Credits.
Data communications including interprocess communication, computer networking, and associated software protocols. Topics include network topologies, point-to-point network protocols, local area networks, and interconnection of networks.
Prerequisites: COS 301. Offered: Spring, odd # years.

COS 389 • Artificial Intelligence 3 Credits.
Basic concepts and techniques of artificial intelligence, including representation, notational structures, searches, control structures, and logic programming languages. Samples of current work in several application areas including natural language systems, expert systems, and neural networks.
Prerequisites: COS 216. Offered: Spring, odd # years.
COS 420 • Software Process 3 Credits.
Balancing the various real-world challenges that a software engineer encounters, including ambiguity, conflicting requirements, task-time estimation, team dynamics, requests from customers, product managers or architects. A team-based software project on a modern computer science topic will be developed during the semester.
Prerequisites: COS 216. Special Notes: Cross listed with ENR 420. COS 477 is a recommended prerequisite. Offered: Spring, odd # years.

COS 450 • Humans and Computers 3 Credits.
Examines the ways that humans and computers interact. Issues in user experience and human-machine interaction are explored. Christian and professional ethics in the development and application of computing technology are extensively examined.
Prerequisites: COS 216. Offered: Interim, even # years. Special Notes: Students may not receive credit for both COS 450 and GES 334K.

COS 477 • Software Engineering 3 Credits.
Formal approach to the design and development of software. Multiple process models discussed and compared. Other topics include design patterns, project management and estimation, team management, formal methods, documentation, system and data description, verification and validation, and process improvement.
Prerequisites: COS 216. Special Notes: Cross listed with ENR 477. Offered: Fall, odd # years.

MAT 101M • Mathematics for the 21st Century 3 Credits.
Mathematical ideas that a liberally educated person should be familiar with in order to function well in a technological society.
Prerequisites: Two years of high school algebra, including logarithms and exponential functions. Offered: Fall, Spring.

MAT 102M • Creative Problem Solving 3 Credits.
An opportunity to learn to use creative thinking and intuition to gain confidence in understanding and solving some intriguing problems in mathematics.
Prerequisites: High school algebra and geometry. Offered: Interim.

MAT 123M • Precalculus 3 Credits.
Mathematics topics required for MAT 124M or further study in the natural sciences. Equations and inequalities; graphs of functions and relations; polynomial, rational, exponential, logarithmic functions; trigonometric functions, identities, equations, and applications.
Prerequisites: Two years of high school algebra; satisfactory completion of the Math department placement requirements. Offered: Fall, Spring.

MAT 124M • Calculus 1 4 Credits.
A mathematical foundation for future college courses and beyond. An introduction to the concepts and methods of the derivative and the integral, and a demonstration of how they are applied in real-world modeling situations. Topics are examined graphically, numerically, and algebraically, including using a symbolic computer algebra system to aid with understanding.
Prerequisites: MAT 123M, Equivalent high school or college course(s); satisfactory completion of Math department placement requirements. Offered: Fall, Spring.

MAT 125 • Calculus 2 4 Credits.
A continuation of the equipping of students with tools for effective problem solving. Study of integration, sequences and series, and introduction to differential equations and approximation techniques. Each topic is approached from several viewpoints (graphical, numerical, algebraic) to involve students with different learning styles.
Prerequisites: MAT 124M. Offered: Fall, Spring.

MAT 201M • Mathematics for Elementary Education 1 3 Credits.
Introduction to problem solving; patterns and sequences; systems of numeration; sets and logic; concepts, operations, and algorithms for each subset of the real numbers; elementary number theory; concepts and applications of ratios, proportions, and percents.
Prerequisites: Major in Elementary Education; minimum ACT mathematics score of 24, minimum SAT mathematics score of 560, or satisfactory completion of Bethel’s online Math for Elementary Education prep course; 15 college-level credits completed. Special Notes: MAT 201M may not be used to fulfill the requirements for a major or minor in Mathematics; Offered: Fall, Spring.
MAT 202 • Mathematics for Elementary Education 2 3 Credits.
Problem-solving and reasoning strategies; algebraic expressions, equations, and functions; data analysis, statistics, combinations/permutations, and probability; concepts and applications of two- and three-dimensional geometry and measurement.
Prerequisites: Grade of C or higher in MAT 201M. Offered: Fall, Spring. Special Notes: MAT 202 may not be used to fulfill the requirements for a major or minor in mathematics.

MAT 207M • Statistical Analysis 3 Credits.
Descriptive and inferential statistics. Specific topics include discrete probability spaces, random variables, distributions, normal distribution, estimation, hypothesis testing, linear regression, correlation analysis. Selected topics could include analysis of variance, goodness-of-fit, and contingency tables. Applications to business, economics, and science.
Offered: Fall, Interim, Spring. Special Notes: Students may not receive credit for both MAT 207M and PSY 230M.

MAT 209 • Financial Mathematics for Actuarial Science 3 Credits.
Topics and problem-solving practice for the actuarial exam in financial mathematics. Theory of interest topics include: time value of money, annuities, cash flows, amortized loans, bonds, portfolios, and immunization. Financial economics topics include: derivatives, options, forwards and futures, swaps, hedging, and investment strategies.
Prerequisites: MAT 125. Offered: Occasionally.

MAT 211 • Linear Algebra 3 Credits.
Linear systems, matrices, vectors and vector spaces, linear transformations, inner products, norms, eigenvalues and eigenvectors, orthogonality, and applications. Provides a foundation for many areas of study in mathematics, computer science, engineering, and science.
Prerequisites: MAT 125, MAT 241. Offered: Spring.

MAT 222 • Differential Equations 3 Credits.
Prerequisites: MAT 125. Offered: Spring. Special Notes: MAT 223 is a preferred prerequisite.

MAT 223 • Multivariable Calculus 3 Credits.
Differential calculus of real functions on R^n: limits, continuity, partial and directional derivatives, mean value theorem, implicit functions, Taylor's Theorem, and optimization techniques (including Lagrange multipliers). Multiple integral theory: change of variables, iterated integrals, and line integration (Green's Theorem).
Prerequisites: MAT 125. Offered: Fall, Spring.

MAT 224 • Differential Equations with Linear Algebra 4 Credits.
Analytic, numerical, qualitative, and linear algebra-based solution methods for ordinary differential equations, along with relevant computations and theoretical concepts from linear algebra as needed, including: matrix operations, vector spaces, basis, dimension, change of basis, and diagonalization.
Prerequisites: MAT 125. Special Notes: Students may not receive credit for both MAT 224 and MAT 222 nor MAT 224 and MAT 211. Offered: Fall.

MAT 241 • Discrete Mathematics 3 Credits.
Covers a collection of topics useful to mathematics and computer science majors. The unifying factor is that topics deal mainly with finite collections of mathematical objects (graphs, trees, finite state machines, etc.). Also includes examination of sets, logic, Boolean algebras, proof techniques, algorithm analysis, counting, and recursion.
Prerequisites: MAT 124M. Offered: Fall.

MAT 310 • Algebraic Structures 4 Credits.
Study of groups, rings, fields, and applications of these algebraic structures from a firm axiomatic foundation with a strong emphasis on properly written proofs.
Prerequisites: MAT 211 (MAT 241 strongly recommended). Offered: Spring.

MAT 330 • Probability and Statistics 3 Credits.
Discrete and continuous probability spaces, distribution and density functions, random variables, sampling, expectation, estimation, and hypothesis testing.
Prerequisites: MAT 125. Offered: Fall.

MAT 331 • Applied Statistics 3 Credits.
Linear and multilinear regression. Factor analysis, including analysis of variance and experimental design.
Prerequisites: MAT 330, Consent of instructor. Offered: Spring, even # years.
MAT 344 • Numerical Methods 3 Credits.
Numerical methods for solving systems of linear equations, finding roots and fixed points, approximating data and functions, numerical integration, finding solutions to differential equations.
Prerequisites: MAT 211, MAT 222. Offered: Spring.
Special Notes: Carries cross-credit in computer science. Knowledge in computing is helpful.

MAT 351 • Modern Geometry 3 Credits.
A survey of informal and formal geometric topics. Investigation of concepts, structure, proof, Euclidean, non-Euclidean, and transformational geometry.
Prerequisites: MAT 241, Consent of instructor.
Offered: Fall, even # years. Special Notes: Designed for students seeking licensure to teach math in grades 5-12.

MAT 376 • Operations Research 4 Credits.
Mathematical techniques used in systems analysis, including linear programming, simulation techniques, and other topics such as transportation models, integer programming, and network analysis.
Prerequisites: COS 105 or COS 205; MAT 211 or MAT 224. Offered: Fall, odd # years.

MAT 422 • Real Analysis 3 Credits.
Elementary set theory, properties of real numbers, functions of real variables, sequences, series, differentiation, Riemann integration, and introduction to topological concepts.
Prerequisites: MAT 223; MAT 310. Offered: Fall.

MAT 425 • Topics in Mathematics 3 Credits.
A seminar designed to provide an in-depth experience with a specific field of mathematics. Topics vary from semester to semester and include logic, number theory, dynamical systems, chaos and fractals, complex analysis, partial differential equations and Fourier analysis, intermediate probability and statistics, combinatorics, and topology.
Corequisites: MAT 310, Consent of instructor.
Offered: Spring, odd # years.

MAT 499 • Foundations of Mathematics 3 Credits.
A short history of mathematics’ major transition points, overview of foundations of mathematics, axiomatic structures, and philosophies of mathematics in relation to Christian faith.
Prerequisites: MAT 330 and one of the following MAT 310, MAT 422. Offered: Interim.