MATHEMATICS, B.S.

Program Description

The Department offers several options for students who are interested in the study of mathematics. Our traditional Mathematics Bachelor of Science program prepares students for a wide variety of career choices and for further study of mathematics in graduate school. In conjunction with the Education Department, we offer a Bachelor of Arts Mathematics program for students who wish to obtain secondary education teaching certification in mathematics. Details on the required courses for each of these programs are given below. In addition to the traditional mathematics program, our department offers a Bachelor of Science in Actuarial Science, which prepares students for careers as Actuaries. For more information on the Actuarial Science programs, please see its separate catalog entry.

Mission Statement

Our mission is in accord with the mission of the University. Learning has the highest priority in the Mathematics program. Our mission is to help our students to observe reality with precision, to think logically, and to communicate effectively. With the ultimate goal of developing our students as self-learners, members of our faculty strive to research and implement teaching strategies that effectively serve the mathematics population.

Students should leave La Salle prepared to enter professional fields that utilize their mathematics education. In addition, students who demonstrate the ability and determination to continue academically will be prepared to pursue graduate studies. We expect that participants in our programs, both students and faculty, will expand their thirst for learning and develop a deeper appreciation and respect for related disciplines. To these ends, we work to provide a classical foundation in the core of the discipline, introduce current theories, research areas, and technologies, and demonstrate the links between theory and its embodiment in the world of applications.

Why Take This Major?

The mathematics major helps one to think logically, to formulate complex problems in a well-defined manner, to critically analyze data, and to determine optimal solutions to real-world problems. All of these skills are transferable to a wide variety of careers that make mathematicians highly sought after in the work force. Mathematics majors often pursue careers as actuaries, statisticians, financial analysts, and teachers, but they are also well-prepared to enter the workforce in a much wider range of career fields.

Degree Earned

B.S.

Required for Graduation

- Courses
  - Major: 16
  - Total: 38
- Credits
  - Major: 56
  - Total: 120
- GPA
  - Major: 2.0
  - Cumulative: 2.0

Student Learning Outcomes

Upon completion of the program, students will be able to:

- demonstrate competency in the areas that comprise the core of the mathematics major
- demonstrate the ability to understand and write mathematical proofs
- be able to use appropriate technologies to solve mathematical problems
- be able to construct appropriate mathematical models to solve a variety of practical problems

Progress Chart

Level One - Core Courses

12 courses and 2 modules required.

Major Requirements

Major requirements include 4 Level Two ILO requirements, *fulfilled through the major.*

Students in this major must complete **38** courses in total in order to graduate. **16** courses will be from this major program.

Code	Title	Credits
Level One - Core Courses		
Universal Required Courses		
Students must complete the following 4 courses.		
ILO 8.1: Written Communication (https://catalog.lasalle.edu/undergraduate/ilo/)		
ENG 110	College Writing I: Persuasion	3
ILO 5.1: Information Literacy (https://catalog.lasalle.edu/undergraduate/ilo/)		
ENG 210	College Writing II: Research	3
ILO 1.1: Understanding Diverse Perspectives (https://catalog.lasalle.edu/undergraduate/ilo/)		
FYS 130	First-Year Academic Seminar [1]	3
ILO 2.1: Reflective Thinking and Valuing (https://catalog.lasalle.edu/undergraduate/ilo/)		
REL 100	Religion Matters	3
Elective Core Courses		
Students must complete 1 course in each of the following 4 ILOs.		
ILO 3.1a: Scientific Reasoning (https://catalog.lasalle.edu/undergraduate/ilo/)		
PHY 105	General Physics I	4
ILO 3.1b: Quantitative Reasoning (https://catalog.lasalle.edu/undergraduate/ilo/)		
MTH 120	Calculus I	4
ILO 6.1: Technological Competency (https://catalog.lasalle.edu/undergraduate/ilo/)		
CSC 230 or CSC 280	Programming Concepts and User Interfaces Object Programming	4
ILO 8.1a/12.1: Oral Communication/Collaborative Engagement (https://catalog.lasalle.edu/undergraduate/ilo/)		

Choose course within ILO (https://catalog.lasalle.edu/undergraduate/ilo/)		3
Distinct Discipline Core Courses		
Students must complete 1 course in each of the following 4 ILOs. Each course must be from a different discipline. (A "discipline" is represented by the 3- or 4-letter prefix attached to each course.)		
ILO 4.1: Critical Analysis and Reasoning (https://catalog.lasalle.edu/undergraduate/ilo/)		
Choose course within ILO (https://catalog.lasalle.edu/undergraduate/ilo/)		3
ILO 9.1: Creative and Artistic Expression (https://catalog.lasalle.edu/undergraduate/ilo/)		
Choose course within ILO (https://catalog.lasalle.edu/undergraduate/ilo/)		3
ILO 10.1: Ethical Understanding and Reasoning (https://catalog.lasalle.edu/undergraduate/ilo/)		
Choose course within ILO (https://catalog.lasalle.edu/undergraduate/ilo/)		3
ILO 11.1: Cultural and Global Awareness and Sensitivity (https://catalog.lasalle.edu/undergraduate/ilo/)		
Choose course within ILO (https://catalog.lasalle.edu/undergraduate/ilo/)		3
Universal Required Modules		
Students must complete the following 2 non-credit modules. [2]		
ILO 7.1a (https://catalog.lasalle.edu/undergraduate/ilo/)		
Health Literacy Module		
ILO 7.1b (https://catalog.lasalle.edu/undergraduate/ilo/)		
Financial Literacy Module		
Major Requirements		
Level Two		
Students must complete 1 course/learning experience in each of the 4 commitments.		
ILO 2.2: Broader Identity (Capstone Course/Experience) (https://catalog.lasalle.edu/undergraduate/ilo/)		
MTH 322	Differential Equations (ILO 2.2)	4
Select one ILO from 3.2a, 3.2b, 4.2, 5.2, 6.2, 7.2a, or 7.2b: Expanded Literacies (https://catalog.lasalle.edu/undergraduate/ilo/)		
MTH 341	Abstract Algebra (ILO 3.2b)	3
ILO 8.2b: Effective Expression (Writing-Intensive Course) (https://catalog.lasalle.edu/undergraduate/ilo/)		
MTH 302	Foundations of Mathematics (ILO 8.2b)	3
Select one ILO from 10.2, 11.2, or 12.2: Active Responsibility (https://catalog.lasalle.edu/undergraduate/ilo/)		
MTH 410	Probability (ILO 10.2)	3
All Other Required Courses		
Required Courses for the Mathematics B.S. Program		
MTH 120	Calculus I	4
MTH 121	Calculus II	4
MTH 222	Calculus III	4
MTH 240	Linear Algebra	4
MTH 302	Foundations of Mathematics	3
MTH 322	Differential Equations	4
MTH 341	Abstract Algebra	3
MTH 410	Probability	3
MTH 411	Mathematical Statistics	3

4 MTH electives at 300-level or higher		12-16
PHY 105	General Physics I	4
Select two of the following:		8
CSC 230	Programming Concepts and User Interfaces	
CSC 280	Object Programming	
CSC 290	Introduction to Data Structures and Algorithms	
Free Electives		
In addition to the requirements listed above, students must take enough courses to the fulfill graduation credit requirements for their School and major.		

[1]

NOTE. The following students use Level 2 Capstone Experience in Major instead of FYS 130 First-Year Academic Seminar: Honors, BUSCA, Core-to-Core, Transfer, and Non-Traditional/Evening.

[2]

The Modules are **not** required for Transfer Students, Core-to-Core Students, or BUSCA Students. BUSCA students are required to take modules if/when they pursue a bachelor's degree.

Recommended Course Sequence

Students should complete the Calculus sequence (MTH 120 Calculus I/MTH 121 Calculus II/MTH 222 Calculus III) within their first three semesters. Additionally, MTH 240 Linear Algebra and MTH 302 Foundations of Mathematics should be taken during the sophomore year. Many upper-division courses rely on the knowledge from MTH 302 Foundations of Mathematics, so it is important to take this course prior to the junior year.

Dual Major Requirements

Mathematics students will often pursue a second major, and doing so is encouraged and supported by the department. Fields in which students often pursue a second major include Computer Science, Economics, Finance, Chemistry, and Education. The required courses for the dual major in Secondary Education are listed below. Students who pursue the dual major in Education receive a Bachelor of Arts in Mathematics in addition to a Bachelor of Arts in Education upon graduation.

Required Courses for Mathematics- Secondary Education

12+ Courses

Code	Title	Credits
MTH 120	Calculus I	4
MTH 121	Calculus II	4
MTH 222	Calculus III	4
MTH 240	Linear Algebra	4
MTH 302	Foundations of Mathematics	3
MTH 330	Modern Geometries	3
MTH 341	Abstract Algebra	3
MTH 405	History of Mathematics	3
MTH 410	Probability	3
CSC 230 or CSC 280	Programming Concepts and User Interfaces Object Programming	4
PHY 105	General Physics I	4
One MTH elective at 300-level or higher		3

Additional courses as specified by the Education Department

Total Credits	**42**

Course Descriptions

Math

MTH 101 College Algebra
Topics include functions and graphs; equations and inequalities; systems of equations; polynomial, rational, exponential, and logarithmic functions. Students who have other college credits in mathematics must obtain permission of the department chair to enroll in this course.

MTH 113 Algebra And Trig
This course provides a review of algebra; simultaneous equations; trigonometry; functions and graphs; properties of logarithmic, exponential, and trigonometric functions; problem-solving and modeling. A TI graphing calculator is required.

MTH 114 Applied Business Calculus
An introduction to mathematical modeling and single-variable differential calculus with an emphasis on data analysis and applications to business and economics. Topics include modeling data using polynomial, exponential, and logarithmic functions; rates of change; derivative rules, including the Product Rule and Chain Rule; applications of derivatives. Applications include compound interest; revenue, cost, profit, average cost; break-even analysis; elasticity of demand; marginal cost; optimization; concavity and inflection points. A TI graphing calculator is required. Prerequisite(s): MTH 101 or a Mathematics Placement of 102M

MTH 119 Precalculus
This course provides a review of algebra and trigonometry as a preparation for courses in the calculus sequence. Topics include: exponents and radicals; polynomials and rational expressions; factoring; division with polynomials; solving equations and inequalities in one variable; graphing in the coordinate plane; linear, quadratic, and higher-degree polynomial functions; horizontal and vertical transformations of functions; rational zeros of functions; exponential and logarithmic functions and their graphs; laws of logarithms; solving exponential and logarithmic equations; radian and degree measure; reference angles; trigonometric functions and graphs; right triangle trigonometry; trigonometric identities and formulas; solving trigonometric equations. A TI graphing calculator is required. Prerequisite(s): MTH 101 or a Mathematics Placement of 102M

MTH 120 Calculus I
Topics in this course include functions of various types: rational, trigonometric, exponential, logarithmic; limits and continuity; the derivative of a function and its interpretation; applications of derivatives, including finding maxima and minima and curve sketching; antiderivatives, the definite integral and approximations; the fundamental theorem of calculus; and integration using substitution. A TI graphing calculator is required. Prerequisite(s): MTH 119 or its equivalent

MTH 121 Calculus II
This course addresses differentiation and integration of inverse trigonometric and hyperbolic functions; applications of integration, including area, volume, and arc length; techniques of integration, including integration by parts, partial fraction decomposition, and trigonometric substitution; L'Hopital's Rule; improper integrals; infinite series and convergence tests; Taylor series; parametric equations; polar coordinates; and conic sections. A TI graphing calculator is required. Prerequisite(s): MTH 120

MTH 150 Mathematics: Myths and Realities
This course offers an overview of mathematical concepts that are essential tools in navigating life as an informed and contributing citizen, including logical reasoning, uses and abuses of percentages, financial mathematics (compound interest, annuities), linear and exponential models, fundamentals of probability, and descriptive statistics. Applications include such topics as population growth models, opinion polling, voting and apportionment, health care statistics, and lotteries and games of chance.

MTH 170 Special Topics

MTH 221 Calculus & Anal Geom II
This course addresses differentiation and integration of inverse trigonometric and hyperbolic functions; applications of integration, including area, volume, and arc length; techniques of integration, including integration by parts, partial fraction decomposition, and trigonometric substitution; L'Hopital's Rule; improper integrals; infinite series and convergence tests; Taylor series; parametric equations; polar coordinates; and conic sections. A TI graphing calculator is required. Prerequisite: MTH 120.

MTH 222 Calculus III
This course addresses three-dimensional geometry, including equations of lines and planes in space, and vectors. It offers an introduction to multi-variable calculus including vector-valued functions, partial differentiation, optimization, and multiple integration. Applications of partial differentiation and multiple integration. A TI-89 graphing calculator is required. Prerequisite(s): MTH 121

MTH 240 Linear Algebra
This course includes vectors and matrices, systems of linear equations, determinants, real vector spaces, spanning and linear independence, basis and dimension, linear transformations, eigenvalues and eigenvectors, and orthogonality. Applications in mathematics, computer science, the natural sciences, and economics are included. Prerequisite(s): MTH 120

MTH 260 Discrete Structures I
This course is the first half of a two-semester course in discrete mathematics and is intended for computer science and information technology majors. Topics in the course include logic, sets, functions, numeric bases, matrix arithmetic, divisibility, modular arithmetic, elementary combinatorics, probability, graphs, and trees. There will be an emphasis on applications to the broad field of computing. Prerequisite(s): MTH 101 or a Mathematics Placement of 102M

MTH 261 Discrete Structures II
This course is the second half of a two-semester course in discrete mathematics and is intended for computer science majors. Topics in the course include rules of inference, proof methods, sequences and summation, growth of functions, complexity of algorithms, prime numbers and their application to cryptography, proof by induction, recursion, recurrence relations, and properties of relations. There will be an emphasis on applications to computer science. Prerequisite(s): MTH 260

MTH 302 Foundations of Mathematics
Topics in this course include propositional logic, methods of proof, sets, fundamental properties of integers, elementary number theory, functions and relations, cardinality, and the structure of the real numbers. Prerequisite(s): MTH 120 Corequisite(s): MTH 121

MTH 321 Real Analysis
This is a course that emphasizes the theory behind calculus topics such as continuity, differentiation, integration, and sequences and series (both of numbers and of functions); basic topology, Fourier Series. Prerequisites: MTH 222 and 302.

MTH 322 Differential Equations
This course focuses on analytical, graphical, and numerical techniques for first and higher order differential equations; Laplace transform methods; systems of coupled linear differential equations; phase portraits and stability; applications in the natural and social sciences. (offered in alternate years) Prerequisite(s): MTH 121

MTH 330 Modern Geometries
Topics from Euclidean geometry including: planar and spatial motions and similarities, collinearity and concurrence theorems for triangles, the nine-point circle and Euler line of a triangle, cyclic quadrilaterals, compass and straightedge constructions. In addition, finite geometries and the classical non-Euclidean geometries are introduced. (offered in alternate years) Prerequisite(s): MTH 240 or MTH 302

MTH 335 Graph Theory
This course introduces students to the field of graph theory and leads them through an exploration of the major branches of this subject, incorporating both theoretical results and current applications for each area studied. From a theoretical perspective, students re-derive well-known existing results and construct proofs related to new topics which have been introduced. From an applied standpoint, members of the class learn to formulate graph models to solve problems in computer science, the natural sciences, engineering, psychology, sociology, and other fields. We also consider some open problems and pose new questions of our own. In addition to fundamental definitions and concepts in graph theory, some specific topics that will be introduced are the following: Eulerian, Hamiltonian, planar, and directed graphs; trees, connectivity, matching, decomposition, coloring, covering, and independent sets and cliques; techniques and algorithms on graphs; and optimization problems and network flows. Prerequisite(s): Junior/senior mathematics standing or permission of the department chair

MTH 341 Abstract Algebra
Sets and mappings; groups, rings, fields, and integral domains; substructures and quotient structures; homomorphisms and isomorphisms; abelian and cyclic groups; symmetric and alternating groups; polynomial rings are topics of discussion in this course. (offered in alternate years) Prerequisite(s): MTH 302

MTH 345 Combinatorics
This course addresses permutations and combinations, generating functions, recurrence relations and difference equations, inclusion/exclusion principle, derangements, and other counting techniques, including cycle indexing and Polya's method of enumeration. Prerequisite(s): MTH 121

MTH 360 Internship/Jrs

MTH 370 Selected Topics in Mathematics
This is an introductory course to specialized areas of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing

MTH 371 Selected Topics in Mathematics
This is an introductory course to specialized areas of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing

MTH 373 Selected Topics in Mathematics
This is an introductory course to specialized areas of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing

MTH 405 History of Mathematics
This course is an in-depth historical study of the development of arithmetic, algebra, geometry, trigonometry, and calculus in Western mathematics (Europe and the Near East) from ancient times up through the 19th century, including highlights from the mathematical works of such figures as Euclid, Archimedes, Diophantus, Fibonacci, Cardano, Napier, Descartes, Fermat, Pascal, Newton, Leibniz, Euler, and Gauss. A term paper on some aspect of the history of mathematics is required. (offered in alternate years) Prerequisite(s): MTH 302

MTH 410 Probability
Topics in this course include sample spaces and probability measures, descriptive statistics, combinatorics, conditional probability, independence, random variables, joint densities and distributions, conditional distributions, functions of a random variable, expected value, variance, various continuous and discrete distribution functions, and the Central Limit Theorem. (offered in alternate years) Prerequisite(s): MTH 222

MTH 411 Mathematical Statistics
Topics in this course include measures of central tendency and variability, random sampling from normal and non-normal populations, estimation of parameters, properties of estimators, maximum likelihood and method of moments estimators, confidence intervals, hypothesis testing, a variety of standard statistical distributions (normal, chi-square, Student's t, and F), analysis of variance, randomized block design, correlation, regression, goodness of fit, and contingency tables. (offered in alternate years) Prerequisite(s): MTH 410

MTH 421 Numerical Analysis
A survey of numerical methods commonly used in algebra and calculus with emphasis on both algorithms and error analysis. Topics include round-off error, numerical methods for solving equations in one variable, interpolation and polynomial approximation, and numerical differentiation and integration. Methods and techniques studied include Bisection, Fixed-Point Iteration, Newton's Method, Müller's Method, Lagrange Polynomials, Neville's Method, Divided Differences, Cubic Splines, Three-point and Five-point Numerical Differentiation Formulas, Newton-Cotes Formulas, Composite Numerical Integration, Adaptive Quadrature, Gaussian Quadrature. Prerequisite(s): MTH 121

MTH 424 Complex Variables
This course examines analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem; power series; infinite series; calculus of residues; contour integration; conformal mapping. Prerequisite(s): MTH 222

MTH 425 Mathematical Modeling
This course addresses the uses of mathematical methods to model real-world situations, including energy management, assembly-line control, inventory problems, population growth, predator-prey models. Other topics include: least squares, optimization methods interpolation, interactive dynamic systems, and simulation modeling. Prerequisite(s): MTH 121

MTH 430 Topology
Topics in the course include topological spaces; subspaces; product spaces, quotient spaces; connectedness; compactness; metric spaces; applications to analysis. (offered in alternate years) Prerequisite(s): MTH 302

MTH 444 Research in MTH I
This course provides the student with an opportunity to do research with a faculty member. The student and the faculty member agree on the research project before the student registers for the course.

MTH 445 Research in MTH II
This course is a continuation of the 444 research course. It provides the student with an opportunity to continue to conduct research with a faculty member.

MTH 450 Cooperative Educ

MTH 460 Internship I

MTH 470 Selected Topics in Mathematics
This course is an introduction to specialized research, concentrating on one particular aspect of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing

MTH 471 Selected Topics in Mathematics
This course is an introduction to specialized research, concentrating on one particular aspect of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing

MTH 473 Selected Topics in Mathematics
This course is an introduction to specialized research, concentrating on one particular aspect of mathematics. The subject matter will vary from term to term. Restriction(s): junior or senior standing

Program Contact Information

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