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Mathematics and Computer Science

Saint Mary's College of California

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MATHEMATICS AND COMPUTER SCIENCE

Mathematics is a liberal art fundamental to a true education. Its study trains students in analytical thinking. Graduates of the department are active in an extraordinarily wide range of careers. The department offers a bachelor of science degree in mathematics with a pure, applied, and computer science track. A minor in mathematics is available.

FACULTY

Jim Sauerberg, Ph.D., *Professor, Chair*
 Kristen Beck, Ph.D., *Assistant Professor*
 Andrew Conner, Ph.D., *Assistant Professor*
 Charles R. Hamaker, Ph.D., *Professor*
 Chris Jones, Ph.D., *Professor*
 Brendan Kneale, FSC, M.A., M.S., *Associate Professor Emeritus*
 Lidia R. Luquet, Ph.D., *Professor Emerita*
 Michael Nathanson, Ph.D., *Associate Professor*
 Brother Raphael Patton, FSC, Ph.D., *Professor Emeritus*
 Kathryn F. Porter, Ph.D., *Professor*
 Jane R. Sangwine-Yager, Ph.D., *Professor Emerita*
 Ellen Veomett, Ph.D., *Associate Professor*

LEARNING OUTCOMES

When they have completed a mathematics major, students will be able to:

- **DEMONSTRATE** a mastery of the core SMC undergraduate mathematics curriculum.
- **COMMUNICATE** mathematical ideas and concepts correctly and clearly in both oral and written forms using mathematical reasoning and terminology and symbolic representation.
- **UNDERTAKE** scholarly investigations using appropriate mathematical resources.
- **INTEGRATE** the use of technological tools into their investigations.
- **DEMONSTRATE** knowledge of connections within mathematics and applications to other fields.

MAJOR REQUIREMENTS

The Department of Mathematics and Computer Science offers three tracks within the mathematics major: Pure, Applied, and Computer Science. Each is a Bachelor of Science degree.

A student wishing to major in mathematics should have a strong interest in the field and normally a background of four years of high school mathematics (two years of algebra, one year of geometry and one year of pre-calculus or equivalent).

LOWER DIVISION

The following lower-division classes are required for all tracks in the mathematics major.

Math 27, Math 38, Math 39, Computer Science 21

Plus either **Physics 1-4** or **Chemistry 8-11**

PURE TRACK

The pure track is designed primarily for students considering graduate study in mathematics or secondary mathematics teaching. It consists of ten (10) upper division courses. Required upper division courses:

Required upper division courses:
Math 103, 111, 120, 150 and 193

Plus two additional courses from:

Math 115, 131 and 185

Plus three upper division mathematics electives.

APPLIED TRACK

The applied track is designed for students planning on entering industry directly from college. It consists of nine (9) upper division courses.

Required upper division courses:

Math 103, 120, and 193

Plus either **Math 111** or **150**

Plus three additional courses from:

Math 113, 114, 134 and CS 102

Plus two upper division electives at most one of which is a Computer Science course.

COMPUTER SCIENCE TRACK

The Computer Science track is designed for students interested in an emphasis in Computer Science. It consists of nine (9) upper-division courses.

Plus either **Math 111** or **150**

Plus three upper-division electives at least two of which are Computer Science courses.

SUGGESTED FOUR-YEAR PROGRAM

First-year students should take **Math 27** and **Math 38** and **CS 21**. Failure to take these courses in the first year may make it impossible to complete the major in four years. It is also recommended for first-year students enroll in **Physics 1, 2, 3, 4** or **Chemistry 8, 9, 10, 11**. Those interested in developing four-year program of study toward a major in mathematics may consult any department faculty member.

MINOR REQUIREMENTS

The minor in mathematics requires **Math 27, Math 28** or **Math 38, Math 103** and two additional upper-division courses in mathematics. **Math 39** and **Math 120** are recommended.

SECONDARY TEACHING

All students in California planning to enroll in a teaching credential program in mathematics after earning their undergraduate degree are required to demonstrate subject matter competency in mathematics prior to enrolling. Students at Saint Mary's College exhibit this competency by taking and passing the CSET (California Subject Exam for Teachers) in mathematics. Students interested in becoming a secondary mathematics teacher are advised to complete the following upper-division courses to prepare for the CSET: **Math 103, 111, 113, 115, 120, 131, 150, 193**.

The California Commission on Teacher Credentialing (CCTC) also requires students to obtain "pre-professional field experience" before entering a credential program. This requirement is satisfied by **EDUC 122: Field Experience**, offered in the January Term. Students are required to contact the School of Education in September of their sophomore or junior year to meet with the faculty member teaching **EDUC 122**. Students should also speak with a representative of the School of Education to learn of any other requirements of the state of California for prospective secondary teachers.

C O U R S E S

PREREQUISITE GRADE

Any course listed in this department with a prerequisite requires a grade of C– or better in the prerequisite course.

LOWER DIVISION

2 Mathematics Readiness

This course covers basic algebra and geometry concepts including number systems, polynomials, solving equations and inequalities, graphs, functions, lines, systems of equations, sets and operations, ratios, proportions, measurement and percentages. Emphasis is on problem solving, critical thinking and mathematical reasoning. *Prerequisites: Level One placement, or permission of Placement Coordinator. This course does NOT satisfy the Mathematical Understanding requirement of the Core Curriculum. Offered each fall and spring.*

3 Finite Mathematics

Topics and applications may include linear equations and matrices, linear programming, probability, finance, Markov chains, game theory and graphs. The emphasis is on applications to business and management sciences. *Prerequisites: Math 2 or Level Two placement, or permission of Placement Coordinator. This course satisfies the Mathematical Understanding requirement of the Core Curriculum. Offered each fall and spring.*

4 Introduction to Probability and Statistics

This course covers the study of combinations and permutations, descriptive and inferential statistics, probability and probability distributions, hypothesis testing, regression and correlation, and applications in a variety of practical settings. Students may not receive credit for both this course and **Business Administration 40**. Students should not take both **Math 4** and **Psychology 103** unless specifically directed by their advisor. *Prerequisite: Math 2 or Level Two placement, or permission of Placement Coordinator. This course satisfies the Mathematical Understanding requirement of the Core Curriculum. Offered each fall and spring.*

5 Mathematics Concepts for the Elementary School Teacher I

The first in a two-course sequence designed for the mathematical preparation of the future elementary school teachers. Covers three of the five California Mathematics Standards; (i) Number and Quantity, (ii) Algebra and Functions, and (iii) Modeling and Problem Solving. Emphasis is on connecting the mathematical content with the Standards of Mathematical Practice from the California Common Core State Standards of Mathematics. This course is only for education track and Teacher for Tomorrow program students in the Justice, Community, and Leadership program. *Prerequisites: Math 2 or Level Two placement, or permission of Placement Coordinator. This course does NOT satisfy the Mathematical Understanding requirement of the Core Curriculum. Offered every fall.*

6 Mathematics Concepts for the Elementary School Teacher II

This is the second course in the two-course sequence. The content addressed covers two of the five California Mathematics Standards; (iv) Geometry and (v) Probability and Statistics. Emphasis will be placed on connecting the content with the Standards of Mathematical Practice from the California Common Core State Standards of Mathematics and mathematical reasoning. This course is only for education track and Teacher for Tomorrow program students in the Justice, Community, and Leadership program. *Prerequisites: Math 5. Satisfies the Mathematical Understanding requirement of the Core Curriculum. Offered every spring.*

10 The Art and Practice of Mathematics

A reflective examination of basic mathematical ideas and patterns. Through participation in the discovery and development of mathematical ideas the student will view the subject as a vehicle for human creativity. The course traces the historical and contemporary role of appropriate mathematical topics. *Prerequisites: English 5 and Collegiate Seminar 2. Satisfies the Mathematical Understanding learning goal of the Core Curriculum. Offered each fall and spring.*

12 Mathematics Readiness for Calculus

This course includes the basic study of number systems, linear equations and inequalities, quadratic equations and inequalities, polynomials, rational expressions, radicals, exponentials, functions, inverse functions, logarithmic and exponential functions, angles, triangles, surface area, volume and applications. Emphasis will be placed on problem solving, critical thinking and mathematical reasoning. Meets four days a week. *Prerequisites: Level Two placement, or permission of Placement Coordinator. Does NOT satisfy the Mathematical Understanding requirement of the Core Curriculum. Offered every fall.*

13 Calculus with Elementary Functions I

The differential calculus of polynomial, rational and algebraic functions, combined with the necessary pre-calculus background review. The **Math 13-14** sequence is equivalent to **Math 27**, and is intended for students needing calculus as part of their major who need to strengthen their pre-calculus skills. Meets four days a week. *Prerequisite: Math 12 or Level Three placement, or permission of Placement Coordinator. This course satisfies the Mathematical Understanding requirement of the Core Curriculum. Offered each fall and spring, and in Jan Term.*

14 Calculus with Elementary Functions II

The differential calculus of trigonometric, logarithmic and exponential functions combined with the necessary pre-calculus background review. The **Math 13-14** sequence is equivalent to **Math 27**, and is intended for students needing calculus as part of their major who need to strengthen their pre-calculus skills. Meets four days a week. *Prerequisite: Math 13 or permission of Placement Coordinator. Offered each fall and spring, and in Jan Term.*

27 Calculus I

Limits, continuity, mathematical reasoning, the derivative, applications of the derivative, antiderivatives and the integral. *Prerequisites: Level Four placement, or permission of Placement Coordinator. This course satisfies the Mathematical Understanding requirement of the Core Curriculum. Offered each fall and spring.*

28 Calculus II with Applications

Topics include techniques and applications of integration, first order differential equations, functions of several variables, double integrals and applications. This course is designed for students majoring in the life sciences, health sciences, business administration, psychology and accounting. *Prerequisite: Math 27 or equivalent. Offered each fall and spring.*

38 Calculus II

Topics include techniques and applications of integration, infinite sequences and series, power series, polar coordinates and inverse trigonometric functions. This course is designed for mathematics, physics, computer science, engineering, and chemistry majors. *Prerequisite: Math 27 or equivalent. Offered every spring.*

39 Calculus III

A rigorous treatment of limits for functions of one and several variables, differentiation and integration of functions of several variables, coordinate systems, vectors, line and surface integrals, Green's, Stokes' and the divergence theorem. Meets four days a week. *Prerequisites: Math 38 or equivalent. Offered every fall.*

Curriculum Mathematics and Computer Science

UPPER DIVISION

Most upper-division courses are offered on a biannual rotation. See the departmental webpage for the schedule.

103 Introduction to Upper Division Mathematics

An introduction to mathematical logic and proofs. Includes an introduction to Abstract Algebra. Students will learn to write proofs using standard proof-writing organization and terminology. Topics from algebra will include the division algorithm, modular arithmetic, and groups. *Prerequisites: English 5 and Math 28 or Math 38. Completion of Math 103 and Math 193 satisfies the Writing in the Disciplines requirement of the Core Curriculum. Offered every fall.*

111 Abstract Algebra I

Topics covered include Modules, vector spaces, fields and Galois theory. *Prerequisites: Math 103 and 120.*

113 Probability and Statistics

Discrete and continuous random variables, expectation and variance, independence, distributions and the Central Limit Theorem. Survey of statistical methods: estimation, sampling, hypothesis testing, linear regression and confidence intervals. *Prerequisites: Math 28 or Math 38.*

114 Mathematical Modeling

An introduction to the formulation, analysis and interpretation of results of mathematical models in the study of real-life problems chosen from the various areas of natural sciences, social sciences, economics and business. *Prerequisites: Math 28 or Math 39, and Computer Science 21.*

115 Number Theory

Results studied include the Fundamental Theorem of Arithmetic, the Euclidean algorithm, Fermat's Little Theorem and Euler's generalization, Diophantine equations and the Law of Quadratic Reciprocity. *Prerequisite: Math 103.*

120 Linear Algebra with Applications

Matrices, simultaneous linear equations, linear transformations, vector spaces, bases, determinants, eigenvectors, Gram-Schmidt orthonormalization, techniques of mathematical proof and applications of linear algebra. Meets four times a week. *Prerequisites: Math 28 or Math 38. Offered every spring.*

131 Topology

This course covers the fundamentals of point-set topology including topological spaces, metric spaces, continuous maps, separation axioms, connectedness, and compactness. *Prerequisite: Math 103.*

134 Differential Equations

Ordinary differential equations, existence and uniqueness theorems, some numerical methods, Laplace transforms, series solutions, linear systems with constant coefficients, partial differential equations, separation of variables, Fourier series. *Prerequisites: Math 39, or Math 38 and Math 120. Offered every spring.*

140 Combinatorics and Discrete Mathematics

This course focuses on discrete structures and their relations. Topics may include counting techniques, relations, graph theory and logic. *Prerequisites: Math 28 or Math 38.*

150 Advanced Calculus

A rigorous review of the theory of single variable calculus, topology of n -space, integration and differentiation, improper integrals, differential forms, the theorems of Stokes and Gauss. *Prerequisites: Math 39 and Math 103.*

185 Complex Variables

Differentiation and integration of analytic functions of a complex variable, power series, residues, conformal mappings. *Prerequisites: Math 39 and Math 103.*

190 Special Topics in Mathematics

An upper division mathematics course not listed above, such as differential geometry, numerical analysis, topology or real analysis. May be repeated for credit as topics vary. *Prerequisites: vary with topics.*

193 Senior Seminar

An in-depth critical examination of a topic or topics in contemporary mathematics. The course consists of directed reading, presentations, research and the writing of a final essay under the supervision of the instructor. At the conclusion of the semester students are expected to present their work at a departmental colloquium of faculty and students. *Prerequisites: Math 103 and Math 193 satisfies the Writing in the Disciplines requirement of the Core Curriculum. Offered in the spring.*

197 Special Study

Independent research of topics not covered in listed courses. *Permission of the chair is required.*

199 Special Study – Honors

Independent study or research for majors with at least a B average in mathematics. *Permission of the chair is required.*

COMPUTER SCIENCE

The courses in computer science emphasize fundamental principles and computer structure. They introduce students to the design and applications of computer systems, and prepare students to use computers as tools in solving complex problems. For 3+2 Computer Science, see 3+2 Engineering Program.

PREREQUISITE GRADES

Any course listed in this department with a prerequisite assumes a grade of C– or better in the prerequisite course.

C O U R S E S

LOWER DIVISION

MA/CS 002 Digital Literacy, Introduction to Web Design

This course introduces students in an accessible way to the basics of digital literacy through web design as a stepping-stone to computer programming concepts and applications. Students are introduced to web development including (1) design principles, (2) information architecture, and (3) interactivity design. Primary development tools include HTML5 and CSS3. Class projects develop knowledge, research and problem solving skills needed for the design, development, and testing of interactive media projects. This course does not fulfill the mathematics core curriculum requirement, nor does it count towards a mathematics major or the 3+2 Engineering Program.

21 Programming

An introduction to problem-solving concepts and program design. Topics covered include top-down design with a structured programming language, bottom-up testing, control statements and structured data types. No prior knowledge of programming is required. The language for the course is Python; students with knowledge of another programming language will find the course valuable. *Prerequisites: Math 27. Offered each spring.*

UPPER DIVISION

Consult the department chair for the schedule of offerings.

102 Advanced Programming

A continuation of **Computer Science 21**. Topics include recursion, an introduction to data structures, analysis of algorithms and object-oriented programming. Programming style and large program development are emphasized. *Prerequisites: Computer Science 21.*

110 Computer Systems

Computer structure and machine languages, assembly language macros, file I/O, program linkage and segmentation. *Prerequisites: Computer Science 102.*

174 Analysis of Algorithms

Basic notions of the design and efficiency of computer algorithms, nonnumerical algorithms for sorting and searching and numerical algorithms. Underlying data structures are examined. *Prerequisites: Computer Science 102 and Math 28.*

190 Topics in Computer Science

This course presents connections among different disciplines which apply the principles of computer science. The theme varies. Students are required to complete a significant project involving their primary discipline. *Prerequisites: varies with topic.*

MA/CS 192 Digital Literacy: Web Programming

This course is a continuation of **MA/CS-002** that introduces students to the basics of digital literacy through web design as a stepping-stone to computer programming concepts and applications. **MA/CS-192** refines & builds upon this knowledge studying JavaScript, jQuery, Web API's and simple mobile applications while implementing a team-oriented project development approach. Other topics include responsive web design, CSS grid systems and HTML5 Canvas. *Prerequisite: MA/CS 002. This course does NOT satisfy the Mathematical Understanding requirement of the Core Curriculum, nor does it count towards a mathematics major or the 3+2 Engineering Program.*

197 Special Study

Independent study in topics not covered in listed courses. *Permission of the department chair is required.*