

## MATHEMATICS PROGRAM LEARNING OUTCOMES

The mathematics program at Chaminade University provides general education requirement in mathematics (MA100 and MA103) to all undergraduate students, teaches supporting mathematics courses to other sciences disciplines (Biology, Forensic Science, Computer Science, Chemistry, and Physics), and offers higher level mathematics courses to students who are pursuing a minor in mathematics.

### **The Mathematics program's objectives are to enable students:**

1. to demonstrate the understanding and skills in reading, interpreting and communicating mathematical contents which are integrated into other disciplines or appear in everyday life;
2. to gain understandings of and skills with logical thinking, deductive and inductive reasoning;
3. to articulate the understanding of more advanced mathematical concepts and quantitative skills to support the study of other disciplines, including skills with numeric and symbolic computations, and problem solving using numeric, analytic and graphic methods; and
4. to develop mathematical maturity to undertake higher level studies in mathematics and related fields.

**The program goals of the mathematics program will be realized from the learning outcomes of the main courses it is offering, as shown in Table 1 below.**

Table 1. Learning Outcomes for Mathematics Courses

<b>Math course</b>	<b>Supporting which course or degree</b>	<b>Learning Outcomes</b>
MA 100	Fulfills Track-A General Education requirement	<ol style="list-style-type: none"> <li>1. Demonstrate the basics of logical thinking and problem solving process.</li> <li>2. Take a survey on the nature of calculation, numbers, and geometry.</li> <li>3. Use basic knowledge in financial management, probability, and statistics to solve applied problems in everyday life.</li> </ol>
MA 103 College Algebra	MA 110, CH 102, CH 203, AC 201, BU 224, BU 324, EC 202	<ol style="list-style-type: none"> <li>1. Demonstrate skills to simplify polynomials (including factoring), rational expressions, radicals and rational exponents.</li> <li>2. Produce solutions to various algebraic equations, linear and quadratic inequalities, and systems of equations</li> <li>3. Demonstrate the use of elementary graphing techniques.</li> <li>4. Describe exponential and logarithmic functions, natural number functions and probability.</li> </ol>
MA 110 Precalculus	CH 203, CH 204, PHY 151, MA 210 Pre-major (minor) requirement for CS/CIS, and CH minor	<ol style="list-style-type: none"> <li>1. Describe basic concepts of functions and their graphs (including increasing and decreasing functions, transformation of functions, composite functions, extreme values of functions, and inverse functions).</li> <li>2. Understand polynomials (including theorems on the zeros of polynomials), rational functions, exponential and logarithmic and trigonometric functions and demonstrate more graphing techniques, sketching their graphs</li> <li>3. Understand definitions of trigonometric functions, and apply the principles of trigonometry to the solution of equations and verification of identities.</li> </ol>
MA 210 Calculus I	PHY 251, MA 211 Pre-major (minor) requirement for FS, BIO, and PHY minor	<ol style="list-style-type: none"> <li>1. Find limits of functions and discuss continuity of functions.</li> <li>2. Find derivatives of algebraic and trigonometric functions (including implicit differentiation, higher order derivatives), and use derivatives to solve applied problems (including related rates, local extrema, Rolle's theorem and the Mean Value theorem, the first and the second derivative tests, concavity, and asymptotes).</li> <li>3. Understand the Fundamental Theorem of Calculus.</li> <li>4. Find integrals of some algebraic and trigonometric functions, use the techniques of integration by substitution and numerical integration, and use integrals to solve applied problems (simple area problems).</li> </ol>

MA 211 Calculus II	PHY 252, PHY 253 MA311 Pre-major requirement for FS, BIO (BS degree), and PHY minor	<ol style="list-style-type: none"> <li>1. Compute derivatives and integrals for common transcendental functions, and analyze their graphs.</li> <li>2. Find indefinite and improper integrals using different integration techniques (including basic integration rules, integration by parts, trigonometric substitution, partial fractions), apply L'Hospital's rule for indeterminate forms.</li> <li>3. Determine the convergence or divergence of infinite series by applying various techniques (including the integral test, P-series, comparison test, alternating series, the ratio and roots tests). Perform standard operations with convergent power series, and find Taylor and Maclaurin representations.</li> <li>4. Write parametric equations of conic sections; sketch their graphs in polar and Cartesian coordinates. Graph polar equations.</li> </ol>
MA311 Calculus III	PHY 310, PHY 311	<ol style="list-style-type: none"> <li>1. Define and use vector operations (including dot product and cross product) in two and three dimensions, find parametric equations of a line, standard equation of a plane in space, and understand cylindrical and spherical coordinates.</li> <li>2. Differentiate and integrate vector-valued functions and find velocity and acceleration along a space curve, curvature and arc length. Determine position function for a projectile.</li> <li>3. Define and use the standard techniques of multivariable calculus, both differential and integral, and utilize them to solve selected applied problems (by applying partial derivatives, directional derivatives, gradients, the chain rule, differentials, the method of Lagrange multipliers, double and triple integrals, center of mass and moments of inertia, or change of variables).</li> <li>4. Define vector fields; find the line and surface integrals, find work, circulation and flux; determine conservative fields and path independence, Green's theorem, divergence theorem, and Stoke's theorem.</li> </ol>
MA 308 Discrete Mathematics	Major requirement for CS and CIS	<ol style="list-style-type: none"> <li>1. Understand logic and propositional calculus, and write a correct formal proof.</li> <li>2. Understand relations and determine types of relations; reflexive, symmetric, antisymmetric, or transitive.</li> <li>3. Understand basics on modular arithmetic.</li> <li>4. Understand fundamentals of graph theory, subgraphs, connection, trees, coloring, Euclidian graphs (including the bridges of Konigsberg , traversable multigraphs).</li> <li>5. Boolean algebra (optional).</li> </ol>

MA331 Intro. Probability & Statistics	Major requirement for FS, CS Pre-major requirement for CIS	<ol style="list-style-type: none"> <li>1. Understand Central Limit Theorem and its application to confidence intervals of mean and proportion; conduct hypothesis testing for mean, deviation, and proportion.</li> <li>2. Understand correlation and regression; know how to perform linear regression analysis.</li> <li>3. Test hypotheses involving one or two variances by using Chi-square and F distributions; perform one-way and two-way analysis of variance.</li> </ol>
MA401 Linear Algebra	MA402 Major requirement for CS, CIS	<ol style="list-style-type: none"> <li>1. Understand the definition of matrix (including some types of matrices), matrix multiplication, and algebraic properties of matrix operations; Perform elementary matrix operations.</li> <li>2. Solve systems of linear equations using matrices.</li> <li>3. Understand vector spaces and subspaces, span and linear independence, basis and dimension; identify and construct examples of elementary vector space ideas in Euclidean n-space as well as in general vector spaces.</li> <li>4. Understand the properties of determinants and find eigenvalues and eigenvectors and use them in diagonalization problems and other applications.</li> </ol>