# WASC ASSESSMENT PLAN

## General Education Requirement

## Mathematics.

## Division of Natural Sciences and Mathematics

## Chaminade University of Honolulu

## A. Mission of the Mathematics Discipline at Chaminade.

Mathematics is offered as a Minor degree at Chaminade. The mission of the Mathematics program is to provide a strong mathematics background for students majoring in science disciplines, as well as to provide the requisite mathematical skills for career success in non-science fields and everyday life. 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.

## B. Core Learning Outcomes (CLO) for the GE Mathematics Requirement.

Students who complete the mathematics requirement of the General Education core at Chaminade will demonstrate:

**1**. An understanding of basic mathematical principles needed to function effectively in our world;

**2**. An understanding of basic symbolic reasoning that can be used to describe relationships and patterns found in nature;

**3.** An understanding of the mathematical tools necessary for success in their selected major.

## C. Mechanisms for fulfilling the GE Mathematics requirement at Chaminade.

**Track A: General Mathematics, MA 100**
This track will satisfy the requirements in most areas in Humanities and Social Sciences and provides a basis in symbolic reasoning essential to descriptions of relationships and patterns in nature. This track will satisfy the math pre-requisite required for the baccalaureate degrees in Criminology and Criminal Justice, English, Historical and Political Studies, Interior Design, Religious Studies, and Social Studies.

**Track B: Algebra/Non-Calculus Based Statistics Preparation, MA 103:**
This track will satisfy the math pre-requisite required for the baccalaureate degrees in Accounting, Business Administration, Management, Behavioral Sciences and Environmental Studies.

**Track C: Elementary Education, MA 105**
This track will satisfy the requirements for teaching of mathematics at the elementary education level and provides a basis in symbolic reasoning essential to descriptions of relationships and patterns in nature.

**Track D: Calculus Series, MA 210**
(Prerequisites are MA 103 and MA 110 or the equivalent in prior learning.) This track will satisfy the basic calculus requirement in Biology, Pre-Med, and Forensic Sciences. Additionally, MA 211 is required for Biology, and Forensic Sciences, the minor in Physics, and MA 331 is required for the major in Forensic Sciences and MA 311 is required for the minor in Physics.

## C.1. Course Descriptions from Chaminade University Catalog

**MA 100 Survey of Mathematics (3 credits)**

Mathematical thought is studied through interactions between the foundations of knowledge and the study of the nature of both algebra and geometry. Issues of mathematical thought are addressed through selected studies of the nature of sets, logic, numbers and operations, algebra, geometry, measurement, financial management, probability, statistics, graphs and functions and mathematical systems. This course fulfills the Track A general education requirement in mathematics. The course is intended as a terminal course and is not a prerequisite for any other course in mathematics. Prerequisites: MA 098 or placement.

**MA 103 College Algebra (3 credits)**

Algebra knowledge and skills for college studies: Sets and real number system; exponents and polynomials, rational and radical expressions; equations and inequalities with applications, including equations containing rational or radical expressions and systems of equations; beginning analytic geometry and functions; exponential and logarithmic functions; the binomial theorem, and progressions. Fulfills Track B general education requirement in mathematics. Not open to students with credits in MA 110, MA 210, or other higher numbered mathematics courses. Prerequisites: MA 098, MA 102 or placement.

**MA 105 Mathematics for Elementary School Teachers (3 credits)**

This course is a foundation for prospective early childhood and elementary education majors with pre-K to 8 mathematics. Guided by NCTM Standards and through the study of concepts and properties of number systems; the four fundamental operations of arithmetic; the basic knowledge in data; the shapes, measurement and transformation of geometric figures; and basic concepts in pre-algebra, the student will be able to undertake further study in mathematics education. This course fulfills the Track C general education requirement in mathematics for Early Childhood Education and Elementary Education majors. Prerequisites: MA 098 or placement

**MA210 Calculus I (4 credits)**

The first course in the calculus sequence. Topics include limits, differentiation and integration of single variable functions which include polynomials, rational powers, and trigonometric functions, the mean value theorem, and the fundamental theorem of calculus. Both concepts and techniques as well as application will be stressed. Fulfills Track D general education requirement in mathematics. Prerequisites: MA 110 or equivalent or placement.

## C.2. Course/Skill Matrix.

| MA Courses | | 098 Basic Skills (MA102 in evening/ online program) | 100 Survey of Math | 103 College Algebra |
|---|---|---|---|---|
| **Core Knowledge Areas for Math** | | | | |
| **Sets of Real Numbers** | | | | |
| | Operations with Real Numbers | x | x | |
| | Integer Exponents and Scientific Notation, Intro | x | x | |
| | Rational exponents and Radicals, Intro | x | x | |
| | Polynomials. Intro | x | | |
| | Factoring Polynomials, Intro | x | | |
| | Algebraic Fractions, Intro | x | | |
| | | | | |
| **Equations and Inequalities** | | | | |

| | | | | |
|---|---|---|---|---|
| | 1.1. Equations | x | x | x |
| | 1.2. Applications of Linear Equations | x | x | x |
| | 1.3. Quadratic Equations | x | x | x |
| | 1.4. Applications of Quadratic Equations | x | | x |
| | 1.5. Complex Numbers | | | x |
| | 1.6. Polynomial and Radical Equations | | | x |
| | 1.7. Inequalities | x | | x |
| | 1.8. Absolute Value | x | | x |
| | | | | |
| **The Rect Coord Sys and Graphs of Eqns** | | | | |
| | 2.1. The Rectangular Coordinate System | x | x | x |
| | 2.2. The Slope of a Nonvertical Line | x | x | x |
| | 2.3. Writing Equations of Lines | x | x | x |
| | 2.4. Graphs of Equations | x | x | x |
| | 2.5. Proportion and Variation | x | x | x |

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| **Algebraic Expressions** | | | | |
| | 3.1. Polynomial Expressions | | | x |
| | 3.2. Rational Expressions | | | x |
| | 3.3. Radical Expressions | | | x |
| | 3.4. Logarithmic Expressions | | | x |
| | 3.5. Exponential Expressions | | | x |
| | | | | |
| **Functions** | | | | |
| | 4.1. Functions and Function Notation | x | x | x |
| | 4.2. Quadratic Functions | x | | x |
| | 4.3. Polynomial and Other Functions | | | |
| | 4.4. Translating and Stretching Graphs | | | x |
| | 4.5. Rational Functions | x | | x |
| | 4.6. Operations on Functions | | | |
| | 4.7. Inverse Functions | | | |
| | | | | |
| **Exponential and Logarithmic Functions** | | | | |
| | 5.1. Exponential Functions and Their Graphs | | x | x |
| | 5.2. Applications of Exponential Functions | | | x |
| | 5.3. Logarithmic Functions and Their Graphs | | | x |
| | 5.4. Applications of Logarithmic Functions | | | |
| | | | | |
| **Linear Systems** | | | | |
| | 6.1. Systems of Linear Equations | x | x | x |
| | 6.2. Gaussian Elimination and Matrix Methods | | | x |

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|---|---|---|---|---|
| | 6.3. Matrix Algebra | | | x |
| | 6.4. Matrix Inversion | | | x |
| | 6.5. Determinants | x | | x |
| | 6.6. Partial Fractions | | | |
| | 6.7. Graphs of Linear Inequalities | x | x | x |
| | 6.8. Linear Programming | | | x |
| | | | | |
| **Conic Sections and Quadratic Systems** | | | | |
| | 7.1. The Circle and the Parabola | | | x |
| | 7.2. The Ellipse | | | |
| | 7.3. The Hyperbola | | | |
| | 7.4. Solving Simultaneous Second-Degree Equations | | | |
| | | | | |
| **Natural-Number Functions** | | | | |
| | 8.1. The Binomial Theorem | | x | x |
| | 8.2. Sequences, Series, and Summation Notation | | | x |
| | 8.3. Arithmetic Sequences | | x | x |
| | 8.4. Geometric Sequences | | x | x |
| | 8.5. Mathematical Induction | | | |
| | 8.6. Permutations and Combinations | | | x |
| | | | | |
| **Probability** | | | | |
| | 9.1. Probability | x | x | x |
| | 9.2. Computation of Compound Probabilities | | x | x |
| | 9.3. Odds and Mathematical Expectation | | x | x |
| | | | | |
| **The Mathematics of Finance** | | | | |
| | 10.1. Interest | x | x | |
| | 10.2. Annuities and Future Value | x | x | |
| | 10.3. Present Value of an Annuity; Amortization | x | x | |

# D. Assessment Plan.

## D.1. Summary of Assessment Strategies by Track

| Track | Terminal Course | Assessment Strategy | Evidence Type (Rubric) | Location of Evidence |
|---|---|---|---|---|
| **A** | MA100 | Delivery of an assessment instrument designed to test appropriate skills related to CLO as a pre- and post-test administered to a | Performance data on MA100 assessment instrument (Rubric A) | Office of the Dean of Natural Sciences and Mathematics |

| | | | | |
|---|---|---|---|---|
| | | cohort of MA100 students each semester. | | |
| **B** | MA103 | Delivery of an assessment instrument designed to test appropriate skills related to CLO as a pre- and post-test administered to a cohort of MA103 students each semester. | Performance data on MA103 assessment instrument (Rubric A) | Office of the Dean of Natural Sciences and Mathematics |
| **C** | MA105 | Per Division of Education | | Office of the Dean of Education |
| **D** | MA210 | Since this is the mathematics requirement for science majors (Biology, Forensic Sciences and Computer Science), we elect to assess performance through the mathematic discipline-specific comprehensive examination that is delivered to all science majors in the semester before graduation. This pre-exit instrument id designed for program assessment and yields information as to the acquisition of advanced mathematical skills relevant to the science majors. | Performance on pre-graduation comprehensive examination (Rubric B). | Office of the Dean of Natural Sciences and Mathematics |

## D.2. Assessment Timeline

| | |
|---|---|
| ***Spring 2008*** | Design and pilot NSM Divisional Exit Instruments (including comprehensive examination of Track D students in Mathematics). Deliver instrument and analyze data each semester. |
| ***Spring 2009*** | Faculty consultation on methodology of assessment for GE Mathematics requirements fulfilled by Tracks A and B. |
| ***Spring 2009*** | Selection of assessment methodology for Tracks A and B. |
| ***Summer 2009*** | Design of draft assessment instruments for Tracks A and B. |
| ***Fall 2009*** | Pilot delivery of assessment instruments for Tracks A and B. |

| | |
|---|---|
| ***Winter 2009 and ongoing.*** | Analyze and reflect on pilot data, refine and develop instruments. Deliver instruments and analyze data each semester. |

## D.3. Instruments.

### *D.3.1. MA100 (Track A) instrument.*

**WASC Assessment Instrument (Track A General Education Mathematics)**
**MA 100**

**1)** **(CLO #3)** Write the number 0.00000053 in scientific notation.

a. $5.3\times10^{-7}$
b. $5.3\times10^{7}$
c. $53\times10^{8}$
d. none of the above

**2)** **(CLO #1)** Let $U=\{0,1,4,9,16,25,36,49,64,81\}$, $A=\{0,9,16,36,64\}$, $B=\{1,9,25,49,81\}$, $C=\{4,64\}$. Please use set theory. Find $A\cup C$.

a. $\{1,9,25,49,81\}$
b. $\{64\}$
c. $\{0,4,9,16,36,64\}$
d. none of the above

**3)** **(CLO # 1,2,3)** Use $|X\cup Y|=|X|+|Y|-|X\cap Y|$ to solve the following problem.

In a marketing survey, you found that 2501 participants consumed diet soda and 3260 consumed regular soda. Of these participants, 125 consumed both diet soda and regular soda. What is the total number of participants in your survey?

a. 6011
b. 5886
c. 5636
d. none of the above

**4)** **(CLO #1)** Simplify. $\sqrt{\frac{3}{5}}$

a. $\frac{\sqrt{3}}{\sqrt{5}}$
b. $\frac{1}{5}\sqrt{5}$
c. $\frac{1}{5}\sqrt{15}$
d. none of the above

**5)** **(CLO #1)** Expand. $(5x-1)(x^2-3x+5)$

a. $5x^3-11x^2+3x-5$
b. $5x^3-16x^2+28x-5$
c. $5x^3-11x^2+28x-5$
d. none of the above

**6)** **(CLO #1)** Factor the expression. $7x^3-11x^2-6x$

a. $x(7x+3)(x-2)$
b. $x(7x-3)(x+2)$
c. $x(7x-3)(x-2)$
d. none of the above

**7)** **( CLO #1,2)** Sara manufactures bicycles and tricycles. She has an order to make 9 cycles using only 21 cycle wheels. Of the 9 cycles made, how many are bicycles, how many are tricycles?

a. 5 bicycles; 4 tricycles
b. 3 bicycles; 6 tricycles
c. 6 bicycles; 3 tricycles
d. none of the above

**8)** **(CLO #1,2)** If a tree cast a shadow of 10ft at the same time a 5ft person casts a shadow of 2ft, how tall is the tree?

a. 25*ft*
b. 20*ft*
c. 35*ft*
d. none of the above

**9)** **(CLO #1,2,3)** Use $A=P\left(1+\frac{r}{n}\right)^{nt}$ to find the future value if $13,000 is invested at 2.5% for 10 years, compounded quarterly (four times a year).

a. $13,000.1
b. $16,705.35
c. $14,625.40
d. none of the above

**10)** **(CLO #1)**A regular deck of 52 playing cards has four suits (spades, hearts. clubs, and diamonds). Each suit contains {2, 3, 4, 5, 6, 7, 8, 9, 10, jack, queen, king, ace}. If you draw one card from a regular deck of cards, what is the probability that the card is a two or a heart?

a. $\frac{4}{13}$

b. $\frac{19}{52}$

c. 13 to 6
d. none of the above

**11) (CLO # 1,2,3)** Most colleges assign the following points to grades; A=4.0, B=3.0, C=2.0, D=1.0, F=0.0. The grades below represent the final grades of a student for one semester. Use $\bar{x} = \frac{\sum (w \cdot x)}{\sum w}$ to calculate the semester grade point average (GPA).

| *Course* | *Grade* | *Number of Credit Hours* |
|---|---|---|
| French | C | 3 |
| Special Topics | A | 4 |
| Math | B | 3 |
| Biology | B | 3 |
| Biology Lab | A | 1 |

a. 3.25
b. 3.20
c. 3.14
d. none of the above

***D.3.2. MA103 (Track B) instrument.***

**WASC Assessment Instrument (Track B General Education Mathematics)**
**MA 103**

**1) (CLO# 1)** Simplify $2a-\left(3b^2-(b^2-a)\right)$

a) $a-2b^2$

b) $a-4b^2$

c) $3a-2b^2$

d) $3a-4b^2$

**2) (CLO# 1)** Simplify $\left(\frac{-2x^2}{y}\right)^3$

a) $\frac{-8x^5}{y^3}$

b) $\frac{-8x^8}{y^3}$

c) $\frac{-8x^6}{y^3}$

d) $\frac{-6x^6}{y^3}$

**3) (CLO# 1,2)** Subtract the rational expressions $\frac{x}{x+5}-\frac{2}{x-3}=$

a) $\frac{x^2-5x+10}{(x+5)(x-3)}$

b) $\frac{x^2-5x-10}{(x+5)(x-3)}$

c) $\frac{x-2}{(x+5)(x-3)}$

d) $\frac{x-2}{8}$

**4) (CLO# 2)** The solution set of $x^2 + x = 12$

a) $\{12,11\}$

b) $\{3,4\}$

c) $\{3,-4\}$

d) $\{-3,-4\}$

**5) (CLO# 1,2,3)** Simplify $\dfrac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-5)}}{2(1)}$

a) $1 \pm 2\sqrt{6}$

b) $1 \pm \sqrt{6}$

c) $1 \pm 25$

d) 3 or -1

**6) (CLO# 2)** The solution set of the inequality $x^2 - 9 > 0$

a) $\{x : x > 3\}$

b) $\{x : x > \pm 3\}$

c) $\{x : -3 < x < 3\}$

d) $\{x : x < -3 \text{ or } x > 3\}$

**7) (CLO# 1,2)** If $\log_3 x = -2$, then $x =$

a) $\dfrac{1}{9}$

b) 9

c) $-6$

d) $-8$

**8) (CLO# 2)** If $32^x = 8$, then $x =$

a) $\dfrac{1}{4}$

b) $\dfrac{5}{3}$

c) $\dfrac{3}{5}$

d) 4

**9) (CLO# 1,2,3)** The line given by the equation $5x - 3y - 1 = 0$ has

a) slope $-5/3$ and *y*-intercept $-1/3$

b) slope $-5/3$ and *y*-intercept $1/3$

c) slope $5/3$ and *y*-intercept $1/3$

d) slope $5/3$ and *y*-intercept $-1/3$

**10) (CLO# 3,2)** A medical researcher needs 2 more volunteers to test the effectiveness of an experimental drug. If 10 people are available to be selected, in how many ways can 2 volunteers be selected?

a) 5

b) 45

c) 90

d) 20

## D.4. Rubrics.

### *D.4.1. Rubric A (MA100 and MA103 instruments)*

| Level of Achievement (percentage score on instrument) | MECHANICS (CLO #1 and 2)<br>The student demonstrates an understanding of mathematical tools and symbolic reasoning | PROBLEM SOLVING (CLO #3)<br>The student demonstrates the mathematical skills related to success in their major |
|---|---|---|
| 1<br>**Exemplary**<br><br>**(>70)** | ***Work is clear, easy to follow, and virtually free of mechanical errors***<br>(always able to perform mathematical or algebraic operations, understands expressions containing exponents or radicals, can factor and simplify complex algebraic expressions) | ***Can apply mathematics to a broad spectrum of problems***<br>(is consistently able to set up and solve multi-stage problems, consistently discerns relevant patterns and determines significance of information) |
| 2<br>**Very Good**<br><br>**(>60)** | ***Work is well presented, but occasionally contains flaws***<br>(occasional difficulty with syntax or order of operations, exponents, radicals and factoring, on occasion flawed simplification of more complex algebraic expressions, can solve most equations and inequalities in one and two variables) | ***Is usually able to make connections between mathematic and other disciplines and can apply mathematics to many practical problems***<br>(usually recognizes and correctly expresses mathematical ideas, is usually able to set up and solve multi-stage problems, usually discerns relevant patterns and significance of information, is usually able to correctly interpret various types of information) |
| 3<br>**Proficient**<br><br>**(>50)** | ***Demonstrates a minimally adequate understanding of the fundamental process of mathematics***<br>(sometimes has difficulties with syntax, order of operations, exponents, radicals and factoring, is sometimes unable to consistently simplify algebraic expressions) | ***Knows concepts, but sometimes has difficulty applying them to practical problems***<br>(sometimes doesn't make connections or has difficulty formulating problems mathematically, sometimes gets lost in the solution of larger problems, sometimes does not correctly interpret information) |
| 4<br>**Incomplete**<br><br>**(>40)** | ***Frequently commits major mechanical errors***<br>(unable to correctly apply the fundamental processes of mathematics or algebra, makes frequent errors in order of operations, exponents and radicals, difficulty with factorization, simplification of algebraic expressions) | ***Is often unable to apply concepts to practical problems***<br>(frequently does not make necessary connections, has a great deal of difficulty formulating problems mathematically, often has difficulty determining relevance of information, often gets lost in the solution of larger problems) |
| 5<br>**Inadequate**<br><br>**(<40)** | ***There are serious and persistent mechanical errors***<br>(major difficulties with the fundamental processes of mathematics and algebra, except for straight forward cases, frequent difficulty dealing with exponents, radicals, factoring, simplifying algebraic expressions, and solving equations and inequalities) | ***Had frequent and persistent difficulty with application of mathematics to practical problems***<br>(has difficulty expressing mathematical ideas, frequently uses the wrong mathematical tool, usually fails to see connections, has many difficulties with problem solving, is usually unable to determine the significance of information) |

### *D.4.2. Rubric B (MA210 Divisional Exit Instrument)*

| Level of Achievement (percentage score on instrument) | MECHANICS (CLO #1 and 2) The student demonstrates an understanding of the mathematics tools and symbolic reasoning which is commensurate with the advanced nature of MA210 (Calculus I) | PROBLEM SOLVING (CLO #3) The student demonstrates the mathematical skills related to success in their major (Biology, Forensic Sciences (FS), Computer Science CS)) |
|---|---|---|
| 1 **Exemplary** **(>70)** | ***Work is clear, easy to follow, and virtually free of mechanical errors*** (always uses acceptable notation, always demonstrates a consistent understanding of the theoretical, geometrical underpinnings of the calculus; uses concepts of function, limit, continuity, derivative, and integral; applies methods of calculus to optimization, graphing, and approximation; applies differential and integral calculus to problems in geometry, and other fields). | ***Can apply mathematics to problems that are designed to apply knowledge of algebra and calculus to either Biology, FS or CS)*** (correctly expresses mathematical ideas, is consistently able to set up and solve multi-stage problems, consistently discerns relevant patterns and determines significance of information) |
| 2 **Very Good** **(>60)** | ***Work is well presented, but occasionally contains flaws*** (occasional difficulty with syntax or order of operations, usually can demonstrate an understanding of the theoretical, geometrical underpinnings of the calculus; uses concepts of function, limit, continuity, derivative, and integral; applies methods of calculus to optimization, graphing, and approximation; applies differential and integral calculus to problems in geometry, and other fields). | ***Is usually able to apply mathematics to problems derived from the Biology, FS, or CS disciplines.*** (usually recognizes and correctly expresses mathematical ideas, is usually able to set up and solve multi-stage problems, usually discerns relevant patterns and significance of information, is usually able to correctly interpret various types of information) |
| 3 **Proficient** **(>50)** | ***Demonstrates a minimally adequate understanding of the fundamental process of mathematics*** (work is not well organized, sometimes has difficulties with the theoretical, geometrical underpinnings of the calculus; with using concepts of function, limit, continuity, derivative, and integral; applying methods of calculus to optimization, graphing, and approximation; applying differential and integral calculus to problems in geometry, and other fields) | ***Knows concepts, but has difficulty applying them to practical problems expressed in terms of Biology, FS or CS.*** (sometimes doesn't make connections or has difficulty formulating problems mathematically, sometimes gets lost in the solution of larger problems, sometimes does not correctly interpret information). |
| 4 **Incomplete** **(>40)** | ***Frequently commits major mechanical errors*** (unable to correctly apply the fundamental processes of calculus, notation is flawed, makes frequent errors in using concepts of function, limit, continuity, derivative, and integral; applying methods of calculus to optimization, graphing, and approximation; applying differential and integral calculus to problems in geometry, and other fields). | ***Is often unable to apply concepts to practical problems when those problems are expressed in terms of Biology, FS or CS.*** (frequently does not make connections, has a great deal of difficulty formulating problems mathematically, often has difficulty determining relevance of information, often gets lost in larger problems). |
| 5 **Inadequate** **(<40)** | ***There are serious and persistent mechanical errors*** (faulty notation and major difficulties with the fundamental processes of processes of calculus, notation is seriously flawed, unable to use concepts of function, limit, continuity, derivative, and integral; apply methods of calculus to optimization, graphing, and approximation; apply | ***Had frequent and persistent difficulty with application of mathematics to practical problems when those problems are expressed in terms of Biology, FS or CS.*** (has difficulty expressing mathematical ideas, frequently uses the wrong tool, fails to see connections, has many difficulties with problem solving, is usually unable to determine the |

| | | |
|---|---|---|
| | differential and integral calculus to problems in geometry, and other fields). | significance of information). |