La Cañada High School

Proposed Course Outline – LC Math 3 Advanced

I. Course Title – LC Math 3 Advanced

II. **Grade Level(s) – Grades 9-12**

III. Length/Credit – 1 Year - 10.0 units of Math Elective

IV. Preparations – Completion of LC Math 1 Advanced and LC Math 2 Advanced, or their equivalents, with a grades of high B or higher. Teacher recommendation is strongly suggested.

V. **Course Description**

This is the third course in an accelerated three-year common core based college preparatory math sequence. The course will be composed of topics relating to Algebra II, Trigonometry, Pre-Calculus, and Statistics. As an advanced course, it will approach these topics with a relatively high level of rigor and extend beyond learning that occurs in LC Math 3. Successful completion of LC Math 3 Advanced positions students to reach advanced math classes, including Calculus, by the senior year.

The main purpose of LC Math 3 Advanced is to formalize and extend students' algebraic experiences from earlier courses. The critical areas of instruction focus on the following key areas: (1) working with inverse functions and related equations, (2) understanding and solving exponential equations with logarithms, (3) working with rational functions and related equations, (4) understanding circular trigonometry, (5) using other trigonometric functions such as tangent secant, etc., (6) working with applied matrices and polar functions and (7) applying statistics to real world problems.

Some of the overarching ideas in the LCM3 Advanced course include: (1) provide opportunities to explore and model concepts verbally, numerically, algebraically, and graphically, (2) the idea of a viable argument, (3) the idea of definitional thinking, (4) the importance of inductive and deductive reasoning as it relates solving problems, making patterns, and applying math learning to real world problems, and (5) the usefulness of Algebra for analyzing the world around us. The Standards for Mathematical Practice will play a prominent role in the course, with students continually developing their ability to reason and argue. Students will solve complex problems, and use tools such as graphing calculators and appropriate technology.

VI. Standards/ESLRs Addressed

1. Standards for Mathematical Practices

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.

- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

Number and Quantity

2. The Complex Number System Standards Abbreviation: N-CN

- Perform arithmetic operations with complex numbers.
- Use complex numbers in polynomial identities and equations.

3. Vector and Matrix Quantities Standards Abbreviation: V-VM

- Perform operations on matrices and use matrices in applications.

Algebra

4. Seeing Structure in Expressions Standards Abbreviation: A-SSE

- Interpret the structure of expressions.
- Write expressions in equivalent forms to solve problems.

5. Arithmetic with Polynomials and Rational Expressions Standards Abbreviation: A-APR

- Perform arithmetic operations on polynomials.
- Understand the relationship between zeros and factors of polynomials.
- Use polynomial identities to solve problems.
- Rewrite rational expressions.

6. Creating Equations Standards Abbreviation: A-CED

- Create equations that describe numbers or relationships.

7. Reasoning with Equations and Inequalities Standards Abbreviation: A - REI

- Understand solving equations as a process of reasoning and explain the reasoning.
- Solve equations and inequalities in one variable.
- Represent and solve equations and inequalities graphically.

Functions

8. Interpreting Functions Standards Abbreviation: F- IF

- Interpret functions that arise in applications in terms of the context.
- Analyze functions using different representations.

9. Building Functions Standards Abbreviation: F- BF

- Build a function that models a relationship between two quantities.

- Build new functions from existing functions.

10. Linear, Quadratic, and Exponential Models Standards Abbreviation: F-LE

- Construct and compare linear, quadratic, and exponential models and solve problems.

11. Trigonometric Functions Standards Abbreviation: F-TF

- Extend the domain of trigonometric functions using the unit circle.
- Model periodic phenomena with trigonometric functions.

- Prove and apply trigonometric identities.

Geometry

12. Expressing Geometric Properties with Equations Standards Abbreviation: G-GPE

- Translate between the geometric description and the equation for a conic section.

13. Circles Standards Abbreviation: G-C

- Find arc lengths and areas of sectors of circles.

Statistics

14. Interpreting Categorical and Quantitative Data Standards Abbreviation: S-ID

- Summarize, represent, and interpret data on a single count or measurement variable.

15. Making Inferences and Justifying Conclusions Standards Abbreviation: S-IC

- Understand and evaluate random processes underlying statistical experiments.
- Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

VII. Brief Course Outline

Essential Course Concepts: Quarter 1: Reasoning with Equations and Inequalities and Interpreting and Building Functions

- Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
- Write a function that describes a relationship between two quantities.
- Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.
- Find inverse functions.
- Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) =2 x3 or f(x) = (x+1)/(x−1) for x ≠ 1.
- Verify by composition that one function is the inverse of another.
- Read values of an inverse function from a graph or a table, given that the function has an inverse.
- Produce an invertible function from a non-invertible function by restricting the domain.
- Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

- For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
- Prove simple laws of logarithms.
- Use the definition of logarithms to translate between logarithms in any base.
- Understand and use the properties of logarithms to simplify logarithmic numeric expressions and to identify their approximate values.

Common Core State Standards Addressed: A-REI 2, F-IF 7.b, F-BF 1c, F-BF 4a, F-BF 4b, F-BF 4c, F-BF 4d, F-BF 5, F-IF 7e, F-LE 4, F-LE 4.1, F-LE 4.2, F-LE 4.3.

Essential Course Concepts: Quarter 2: Rational Functions and Related Equations and the Arithmetic of Rational Expressions

- Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
- Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.
- Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
- Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
- Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
- Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.

Common Core State Standards Addressed: F-IF 7d, A-APR - 6, A-APR 7, A-REI 2, G-GPE 3, F-IF 7e, F-BF 3, F-TF 10, G-C 5

Essential Course Concepts: Quarter 3: Trigonometric Functions and Polar Functions

- Graph all six basic trigonometric functions F-TF 2.1
- Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.F-TF 1
- Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. F-TF 2
- Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. F-TF 4
- Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. F-TF 5
- Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. F-TF 6
- Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. F-TF 7
- Prove the Pythagorean identity $\sin2(\theta) + \cos2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle. F-TF 8
- Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. F-TF 9
- Prove the half angle and double angle identities for sine and cosine and use them to solve problems. F-TF 10
- Graph polar coordinates and curves. Convert between polar and rectangular coordinate systems. F-IF 11
- Given a quadratic equation of the form $ax2 + by2 + cx + dy + e = 0$, use the method for completing the square to put the equation into standard form; identify whether the graph of the equation is a circle, ellipse, parabola, or hyperbola and graph the equation. [In Algebra II, this standard addresses only circles and parabolas.]

Common Core Concepts Addressed: F-TF 1, F-TF 2, F-TF 2.1, F-TF 4, F-TF 5, F-TF 6, F-FT 7, F-TF 8, F-TF 9, F-TF 10, F-IF 11, G.GPE 3.1

Essential Course Concepts: Quarter 4: Applied Matrices and Statistics

- Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
- Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
- Add, subtract, and multiply matrices of appropriate dimensions.
- Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
- Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
- Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

- Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
- Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
- Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- Evaluate reports based on data.

Common Core Concepts Addressed: N-VM 6, N-VM 7, N-VM 8, N-VM 9, N-VM 10,S-ID 4, S-IC 1, S-IC 2, S-IC, 3, S-IC 4, S-IC 5, S-IC 6

VIII. Methods of Assessment

Evaluation:

1. **Examinations**: Examinations are a critical component in monitoring comprehension and in preparing students in the development of key critical thinking, operational and computational skills, data analysis, and reading skills. The examinations in this course will follow the district examination policies. Exams will take the form of tests and quizzes given at appropriate instructional periods.
2. **Projects**: Students will be asked to complete both individual and group projects related to key concepts of this course.
3. **Homework**: Students will be assigned homework daily to provide independent practice opportunities in order to strengthen and deepen key concepts. **Homework intensity for this course expects that students will complete homework that will require approximately 60 minutes daily.**
4. **Class Participation**: Class participation will be graded on a weekly basis.
5. **Final Exam**: A final exam will be given at the conclusion of both first and second semester. It will be a comprehensive exam based upon the course of study completed during the year.

Grades:

All work will be assigned a point value, although not all work will receive a letter grade. Grades are based on total points accumulated during each grading period. I have structured the class in such a way to approximate your grade breaking down into the following percentages:

Examinations:	**75%**	**A= 90-100 %**
Homework/Classwork:	**10%**	**B = 79-89.9 %**
Final Exam:	**15%**	**C = 67- 78.9 %**
		D = 55-66.9 %
		F = Below 54.9 %

IX. Materials/Textbook(s)

Algebra 2, Student Common Core Edition, John Carter, et al. McGraw-Hill/Glencoe, 2016. (Proposed - Not Yet Adopted by LCUSD)

X. Seeking "a-f" Approval – Yes/No – Yes, this course will be submitted to the University of California for approval for the 2017-18 academic year in the subject domain "C" for mathematics.

XI. Seeking AP Class Approval – Yes/No – This course does NOT seek AP approval.