Common Core Standards & CSD Curriculum Alignment

2014/2015 Curriculum Map –Pre-Calculus – Middlestead and Evinger

Estimated Duration of Unit	Unit Title/Theme	Content Big Ideas/Goals	Instructional Activities Examples	CCSS Emphasis (Primary CCS in Bold)
40 Days	Unit 1: Complex Numbers and Transformations	**Perform arithmetic operations with complex numbers.** **Represent complex numbers and their operations on the complex plane.** **Perform operations on matrices and use matrices in applications.**	Extending their understanding of complex numbers to points in the complex plane, students come to understand that multiplying a given set of points by a complex number amounts to rotating and dilating those points in the complex plane about zero.	**N-CN.3** (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. **N-CN.4** (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number. **N-CN.5** (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. *For example,* $(-1 + \sqrt{3}\, i)^3 = 8$ *because* $(-1 + \sqrt{3}\, i)$ *has modulus 2 and argument 120°.* **N-CN.6** (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints. **N-VM.10**[67] (+) 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. **N-VM.11** (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. **N-VM.12** (+) Work with 2 x 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.

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40 Days	**Unit 1: Complex Numbers and Transformations**	**Experiment with transformations in the plane**	Extending their understanding of complex numbers to points in the complex plane, students come to understand that multiplying a given set of points by a complex number amounts to rotating and dilating those points in the complex plane about zero.	**G-CO.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch). **G-CO.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. **G-CO.5** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

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Estimated Duration of Unit	Unit Title/Theme	Content Big Ideas/Goals	Instructional Activities Examples	CCSS Emphasis (Primary CCS in Bold)
40 Days	Unit 2: **Vectors and Matrices**	**Represent and model with vector quantities Perform operations on vectors. Perform operations on matrices and use matrices in applications.**	Students study matrices and vectors as objects in their own right. Students interpret the properties and operations of matrices to learn multiple ways to solve problems with them, including solving systems of linear equations. They construct viable arguments using matrices to once again derive equations for conic sections, this time by translating and rotating the locus of points into a "standard" position using matrix operations. (For example, applying rigid motions to move the directrix of a parabola to one of the coordinate axes.)	**N-VM.1** (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., **v**, |**v**|, ||**v**||, *v*). **N-VM.2** (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. **N-VM.3** (+) Solve problems involving velocity and other quantities that can b **N-VM.4** (+) Add and subtract vectors. a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. c. Understand vector subtraction **v** – **w** as **v** + (–**w**), where –**w** is the additive inverse of **w**, with the same magnitude as **w** and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise. **N-VM.5** (+) Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$. b. Compute the magnitude of a scalar multiple c**v** using ||c**v**|| = |c|v. Compute the direction of c**v** knowing that when |c|v ≠ 0, the direction of c**v** is either along **v** for (c > 0) or against **v** (for c < 0). e represented by vectors. **N-VM.6** (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

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40 Days	Unit 2: **Vectors and Matrices**	**Perform operations on matrices and use matrices in applications** **Solve systems of equations** **Translate between the geometric description and the equation for a conic section**	Students study matrices and vectors as objects in their own right. Students interpret the properties and operations of matrices to learn multiple ways to solve problems with them, including solving systems of linear equations. They construct viable arguments using matrices to once again derive equations for conic sections, this time by translating and rotating the locus of points into a "standard" position using matrix operations. (For example, applying rigid motions to move the directrix of a parabola to one of the coordinate axes.)	**N-VM.7** (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. **N-VM.8** (+) Add, subtract, and multiply matrices of appropriate dimensions. **N-VM.9** (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. **N-VM.10** (+) 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. **N-VM.11** (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. **N-VM.12** (+) Work with 2 x 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area. **A-REI.8** (+) Represent a system of linear equations as a single matrix equation in a vector variable. **A-REI.9** (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 x 3 or greater) **G-GPE.1** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. **G-GPE.2** Derive the equation of a parabola given a focus and directrix. **G-GPE.3** (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant. .

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25 Days	Unit 3: **Rational and Exponential Functions**	**Use complex numbers in polynomial identities and equations.** **Use polynomial identities to solve problems** **Rewrite rational expressions** **Analyze functions using different representations** **Build a function that models a relationship between two quantities**	Students study rational and exponential functions. They graph rational functions by extending what they learned about graphing polynomials functions. Students, through repeatedly exploiting the relationship between exponential and logarithmic functions, learn the meaning of inverse functions. Additionally, students learn to explicitly build composite functions to model relationships between two quantities. In particular, they analyze the composite of two functions in describing the relationship of three or more quantities in modeling activities in this unit.	**N-CN.8** (+) Extend polynomial identities to the complex numbers. *For example, rewrite* $x^2 + 4$ *as* $(x + 2i)(x - 2i)$. **N-CN.9** (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. **A-APR.5** (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of *x* and *y* for a positive integer *n*, where *x* and *y* are any numbers, with coefficients determined for example by Pascal's Triangle. **A-APR.5** (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of *x* and *y* for a positive integer *n*, where *x* and *y* are any numbers, with coefficients determined for example by Pascal's Triangle. **A-APR.7** (+) 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. **F-IF.7** Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. **F-IF.9**[69] Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). **F-BF.1** Write a function that describes a relationship between two quantities.★ c. (+) Compose functions.

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25 Days	Unit 3: **Rational and Exponential Functions**	**Build new functions from existing functions** **Explain volume formulas and use them to solve problems**	Students study rational and exponential functions. They graph rational functions by extending what they learned about graphing polynomials functions. Students, through repeatedly exploiting the relationship between exponential and logarithmic functions, learn the meaning of inverse functions. Additionally, students learn to explicitly build composite functions to model relationships between two quantities. In particular, they analyze the composite of two functions in describing the relationship of three or more quantities in modeling activities in this unit.	**F-BF.4** Find inverse functions. b. (+) Verify by composition that one function is the inverse of another. c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. d. (+) Produce an invertible function from a non-invertible function by restricting the domain. **F-BF.5** (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. **G-GMD.2** (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

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30 Days	Unit 4: **Trigonometry**	**Extend the domain of trigonometric functions using the unit circle** **Model periodic phenomena with trigonometric functions** **Model periodic phenomena with trigonometric functions** **Prove and apply trigonometric identities** **Apply trigonometry to general triangles** **Understand and apply theorems about circles**	Students visualize graphs of trigonometric functions with the aid of appropriate software and interpret how a family of graphs defined by varying a parameter in a given function changes based upon that parameter. They analyze symmetry and periodicity of trigonometric functions. They extend their knowledge of inverse functions to trigonometric functions by restricting domains to create the inverses, and apply inverse functions to solve trigonometric equations that arise in modeling contexts. Students also construct viable arguments to prove the Law of Sines, Law of Cosines, and the addition and subtraction formulas for the trigonometric functions.	**F-TF.3** (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π–*x*, π+*x*, and 2π–*x* in terms of their values for *x*, where *x* is any real number. **F-TF.4** (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. **F-TF.6** (+) 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.7** (+) 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.9**70 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. **G-SRT.9** (+) Derive the formula *A = 1/2 ab* sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. **G-SRT.10** (+) Prove the Laws of Sines and Cosines and use them to solve problems. **G-SRT.11** (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces). **G-C.4** (+) Construct a tangent line from a point outside a given circle to the circle.

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30 Days	**Unit # 5: Probability and Statistics**	**Perform operations on matrices and use matrices in applications.** **Use the rules of probability to compute probabilities of compound events in a uniform probability model** **Calculate expected values and use them to solve problems** **Use probability to evaluate outcomes of decisions**	Students will be modeling with probability and statistics in which students consolidate their study of statistics as they analyze decisions and strategies using newly refined skills in calculating expected values.	**N-VM.6** (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. **N-VM.7** (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. **S-CP.8** (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. **S-CP.9** (+) Use permutations and combinations to compute probabilities of compound events and solve problems. **S-MD.1** (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. **S-MD.2** (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. **S-MD.3** (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. **S-MD.4** (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. **S-MD.5** (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance b. Evaluate and compare strategies on the basis of expected values. **S-MD.6** (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). **S-MD.7** (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

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