South Carolina College- and Career-Ready (SCCCR) Pre-Calculus

Key Concepts	Standards	
Arithmetic with Polynomials and Rational Expressions	**The student will:**	
	PC.AAPR.2	Know and apply the Division Theorem and the Remainder Theorem for polynomials.
	PC.AAPR.3	Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph.
	PC.AAPR.4	Prove polynomial identities and use them to describe numerical relationships.
	PC.AAPR.5	Apply the Binomial Theorem to expand powers of binomials, including those with one and with two variables. Use the Binomial Theorem to factor squares, cubes, and fourth powers of binomials.
	PC.AAPR.6	Apply algebraic techniques to rewrite simple rational expressions in different forms; using inspection, long division, or, for the more complicated examples, a computer algebra system.
	PC.AAPR.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.
Reasoning with Equations and Inequalities	**The student will:**	
	PC.AREI.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. Understand that such systems may have zero, one, two, or infinitely many solutions.
	PC.AREI.8	Represent a system of linear equations as a single matrix equation in a vector variable.
	PC.AREI.9	Using technology for matrices of dimension 3×3 or greater, find the inverse of a matrix if it exists and use it to solve systems of linear equations.
	PC.AREI.11	Solve an equation of the form $f(x) = g(x)$ graphically by identifying the x-coordinate(s) of the point(s) of intersection of the graphs of $y = f(x)$ and $y = g(x)$.
Structure and Expressions	**The student will:**	
	PC.ASE.1	Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
	PC.ASE.2	Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.
	PC.ASE.4	Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems including applications to finance.

Building Functions	**The student will:**	
	PC.FBF.1	Write a function that describes a relationship between two quantities. b. Combine functions using the operations addition, subtraction, multiplication, and division to build new functions that describe the relationship between two quantities in mathematical and real-world situations.
	PC.FBF.3	Describe the effect of the transformations $kf(x)$, $f(x)+k$, $f(x+k)$, and combinations of such transformations on the graph of $y=f(x)$ for any real number k. Find the value of k given the graphs and write the equation of a transformed parent function given its graph.
	PC.FBF.4	Understand that an inverse function can be obtained by expressing the dependent variable of one function as the independent variable of another, as f and g are inverse functions if and only if $\mathrm{f(x)} = \mathrm{y}$ and $\mathrm{g(y)} = \mathrm{x}$, for all values of x in the domain of f and all values of y in the domain of g, and find inverse functions for one-to-one function or by restricting the domain. a. Use composition to verify one function is an inverse of another. b. If a function has an inverse, find values of the inverse function from a graph or table.
	PC.FBF.5	Understand and verify through function composition that exponential and logarithmic functions are inverses of each other and use this relationship to solve problems involving logarithms and exponents.
Interpreting Functions	**The student will:**	
	PC.FIF.4	Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
	PC.FIF.5	Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
	PC.FIF.6	Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.

	PC.FIF.7	Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. *(Note: PC.FIF.7a – d are not Graduation Standards.)* a. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. b. Graph radical functions over their domain show end behavior. c. Graph exponential and logarithmic functions, showing intercepts and end behavior. d. Graph trigonometric functions, showing period, midline, and amplitude.
Linear, Quadratic, and Exponential	**The student will:**	
	PC. FLQE.4	Express a logarithm as the solution to the exponential equation, $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
Trigonometry	**The student will:**	
	PC.FT.1	Understand that the radian measure of an angle is the length of the arc on the unit circle subtended by the angle.
	PC.FT.2	Define sine and cosine as functions of the radian measure of an angle in terms of the x- and y-coordinates of the point on the unit circle corresponding to that angle and explain how these definitions are extensions of the right triangle definitions. a. Define the tangent, cotangent, secant, and cosecant functions as ratios involving sine and cosine. b. Write cotangent, secant, and cosecant functions as the reciprocals of tangent, cosine, and sine, respectively.
	PC.FT.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for $\frac{\pi}{3}$, $\frac{\pi}{4}$, and $\frac{\pi}{6}$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.
	PC.FT.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
	PC.FT.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
	PC.FT.6	Define the six inverse trigonometric functions using domain restrictions for regions where the function is always increasing or always decreasing.
	PC.FT.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.

	PC.FT.8	Justify the Pythagorean, even/odd, and cofunction identities for sine and cosine using their unit circle definitions and symmetries of the unit circle and use the Pythagorean identity to find $\sin A$, $\cos A$, or $\tan A$, given $\sin A$, $\cos A$, or $\tan A$, and the quadrant of the angle.
	PC.FT.9	Justify the sum and difference formulas for sine, cosine, and tangent and use them to solve problems.
Circles	**The student will:**	
	PC.GCI.5	Derive the formulas for the length of an arc and the area of a sector in a circle, and apply these formulas to solve mathematical and real-world problems.
Expressing Geometric Properties with Equations	**The student will:**	
	PC.GGPE.2	Use the geometric definition of a parabola to derive its equation given the focus and directrix.
	PC.GGPE.3	Use the geometric definition of an ellipse and of a hyperbola to derive the equation of each given the foci and points whose sum or difference of distance from the foci are constant.
Similarity, Right Triangles, and Trigonometry	**The student will:**	
	PC.GSRT.9	Derive the formula $A = \frac{1}{2}ab\sin C$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
	PC.GSRT.10	Prove the Laws of Sines and Cosines and use them to solve problems.
	PC.GSRT.11	Use the Law of Sines and the Law of Cosines to solve for unknown measures of sides and angles of triangles that arise in mathematical and real-world problems.
Complex Number System	**The student will:**	
	PC.NCNS.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
	PC.NCNS.3	Find the conjugate of a complex number in rectangular and polar forms and use conjugates to find moduli and quotients of complex numbers.
	PC.NCNS.4	Graph complex numbers on the complex plane in rectangular and polar form and explain why the rectangular and polar forms of a given complex number represent the same number.
	PC.NCNS.5	Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.
	PC.NCNS.6	Determine the modulus of a complex number by multiplying by its conjugate and determine the distance between two complex numbers by calculating the modulus of their difference.
	PC.NCNS.7	Solve quadratic equations in one variable that have complex solutions.

	PC.NCNS.8	Extend polynomial identities to the complex numbers and use DeMoivre's Theorem to calculate a power of a complex number.
	PC.NCNS.9	Know the Fundamental Theorem of Algebra and explain why complex roots of polynomials with real coefficients must occur in conjugate pairs.
Vector and Matrix Quantities	**The student will:**	
	PC.NVMQ.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.
	PC.NVMQ.2	Represent and model with vector quantities. Use the coordinates of an initial point and of a terminal point to find the components of a vector.
	PC.NVMQ.3	Represent and model with vector quantities. Solve problems involving velocity and other quantities that can be represented by vectors.
	PC.NVMQ.4	Perform operations on vectors. a. Add and subtract vectors using components of the vectors and graphically. b. Given the magnitude and direction of two vectors, determine the magnitude of their sum and of their difference.
	PC.NVMQ.5	Multiply a vector by a scalar, representing the multiplication graphically and computing the magnitude of the scalar multiple.
	PC.NVMQ.6*	Use matrices to represent and manipulate data. *(Note: This Graduation Standard is covered in Grade 8.)*
	PC.NVMQ.7	Perform operations with matrices of appropriate dimensions including addition, subtraction, and scalar multiplication.
	PC.NVMQ.8	Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
	PC.NVMQ.9	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.
	PC.NVMQ.10	Multiply a vector by a matrix of appropriate dimension to produce another vector. Work with matrices as transformations of vectors.
	PC.NVMQ.11	Apply 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.