Honors Pre-Calculus

Diocese of Greensburg Curriculum

Unit	Standards	Content	Skills
Coordinate Geometry	**NCTM: Mathematics** **NCTM: Grades 9 - 12** **Number & Operations** **Understand numbers, ways of representing numbers, relationships among numbers, and number systems** compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions; **Compute fluently and make reasonable estimates** develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases. judge the reasonableness of numerical computations and their results. **Algebra** **Represent and analyze mathematical situations and structures using algebraic symbols** understand the meaning of equivalent forms of expressions, equations, inequalities, and relations; write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency-mentally or with paper and pencil in simple cases and using technology in all cases;	• Interval and Set Notation • Imaginary Numbers • Real Numbers, Exponents, and Radicals (x^(a/b)) Solving Rational Equations & Inequalities • Solving Radical Equations & Inequalities • Factoring • Quadratic Formula/Completing the Square • Inequalities • Absolute Value Inequalities • Distance and Midpoint • Linear Functions • Variation • Circles • Completing the Square	**Students will be able to:** **Knowledge** Define a function **Comprehension** • Calculate Distance and Midpoint • Review Intercepts • Solve problems that involve Real Numbers, Exponents, and Radicals (x^(a/b)) • Solve Algebraic Rationals • Solve Equations • Solve Factoring Problems • Solve Inequalities • Solve Absolute Value Inequalities

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Functions	**CCSS: Mathematics** **CCSS: HS: Functions** **Interpreting Functions** **HSF-IF.B. Interpret functions that arise in applications in terms of the context.** HSF-IF.B.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. **HSF-IF.C. Analyze functions using different representations.** HSF-IF.C.7a. Graph linear and quadratic functions and show intercepts, maxima, and minima. HSF-IF.C.7b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. **Building Functions** **HSF-BF.B. Build new functions from existing functions.** HSF-BF.B.3. Identify the effect on the graph of replacing f(x) by f(x) + k, k f(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. **NCTM: Mathematics** **NCTM: Grades 9 - 12** **Algebra**	Define Functions • Sets and Set Notation • Domain and Range Transformations • Translation • Reflection • Dilation Functions • Quadratic • Cubic • Radical • Rational • Absolute Value • Logarithmic/Exponential • Piecewise Functions Composite Functions Inverse Functions Zeros of a polynomial Function End behavior	**Students will be able to:** **Knowledge** Define translation, reflection, and dilation Define domain and range **Comprehension** Identify parts of a function that affect transformations Identify linear, quadratic, cubic, radical, rational, absolute value, logarithmic, and exponential functions Identify graphs of circles **Analysis** Compute inverse functions **Synthesis**

	Understand patterns, relations, and functions generalize patterns using explicitly defined and recursively defined functions; analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior; understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions understand and compare the properties of classes of functions, including exponential, polynomial, rational, logarithmic, and periodic functions; **Analyze change in various contexts** approximate and interpret rates of change from graphical and numerical data. **Geometry** **Apply transformations and use symmetry to analyze mathematical situations** understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, coordinates, vectors, function notation, and matrices; use various representations to help understand the effects of simple transformations and their compositions. 		Predict graphs of composite functions
Trigonometry with Degree Measure	**CCSS: Mathematics** **CCSS: HS: Functions** **Trigonometric Functions**	• Sine, Cosine, Tangent, Cosecant, Secant, Cotangent	**Students will be able to:**

	HSF-TF.A. Extend the domain of trigonometric functions using the unit circle. HSF-TF.A.3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for p/3, p/4 and p/6, and use the unit circle to express the values of sine, cosines, and tangent for x, p + x, and 2p – x in terms of their values for x, where x is any real number. **CCSS: HS: Geometry** **Similarity, Right Triangles, & Trigonometry** **HSG-SRT.C. Define trigonometric ratios and solve problems involving right triangles** HSG-SRT.C.6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. HSG-SRT.C.7. Explain and use the relationship between the sine and cosine of complementary angles. HSG-SRT.C.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **HSG-SRT.D. Apply trigonometry to general triangles** HSG-SRT.D.9. (+) Derive the formula A = ½ ab sin© for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. HSG-SRT.D.10. (+) Prove the Laws of Sines and Cosines and use them to solve problems. HSG-SRT.D.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).	• Coterminal and Reference Angles • Special Right Triangles • ASTC • Quadrantal Angles • Inverse Trig Functions • Oblique Triangles • Law of Sines and Law of Cosines	**Knowledge** State and demonstrate understanding of the trig ratios **Comprehension** Understand the difference between inverse trig functions and trig inverses **Application** Compute the cosecant, secant, and cotangent. **Analysis** Determine what coefficients and constants transform the functions Solve oblique triangles **Synthesis** Construct the law of sines and cosines

	NCTM: Mathematics **NCTM: Grades 9 - 12** **Geometry** **Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships** use trigonometric relationships to determine lengths and angle measures. 		
Midterm			
Trigonometry with Radian Measure	**CCSS: Mathematics** **CCSS: HS: Functions** **Trigonometric Functions** **HSF-TF.A. Extend the domain of trigonometric functions using the unit circle.** HSF-TF.A.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. HSF-TF.A.2. 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. HSF-TF.A.4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. **HSF-TF.C. Prove and apply trigonometric identities.**	• Unit Circle • Radian Measure • Arc Length • Area of Sector • Linear and Angular Velocity • Graphing Trig Functions with amplitude, change in period, vertical shift, and phase shift • Inverse Trigonometric Functions	**Students will be able to:** **Knowledge** Define a radian **Comprehension** Memorize the unit circle and demonstrate understanding Demonstrate understanding of the difference between inverse trig functions and trig inverses

	HSF-TF.C.8. Prove the Pythagorean identity sin²(?) + cos²(?) = 1 and use it to calculate trigonometric ratios. **CCSS: HS: Geometry** **Circles** **HSG-C.B. Find arc lengths and areas of sectors of circles** HSG-C.B.5. 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. 		**Application** Apply sine, cosine, and tangent functions to the unit circle Compute the cosecant, secant, and cotangent. **Analysis** Construct graphs of all trig and inverse of trig functions Determine what coefficients and constants transform the functions **Synthesis**
Trigonometric Identities	**CCSS: Mathematics** **CCSS: HS: Algebra** **Seeing Structure in Expressions** **HSA-SSE.A. Interpret the structure of expressions.** HSA-SSE.A.2. Use the structure of an expression to identify ways to rewrite it. **HSA-SSE.B. Write expressions in equivalent forms to solve problems.** HSA-SSE.B.3. Choose and produce an equivalent form of an expression to reveal and	• Factoring expressions that contain trig functions • Verifications/simplifying trig expressions • Sum & Difference formulas • Double Angle Formula • Half Angle Formula • Product-Sum and Sum-Product Formulas • Harmonic Motion	**The students will be able to:** **Knowledge** State the trigonometric identities **Application:**

	explain properties of the quantity represented by the expression. **CCSS: HS: Functions** **Trigonometric Functions** **HSF-TF.C. Prove and apply trigonometric identities.** HSF-TF.C.8. Prove the Pythagorean identity sin²(?) + cos²(?) = 1 and use it to calculate trigonometric ratios. HSF-TF.C.9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. © Copyright 2010. National Governors Association Center for Best Practices and Council of Chief State School Officers. All rights reserved.		Use factoring techniques to factor trigonometric expressions Simplify trig expressions Use sum/difference, double, half, product-sum and sum-product formulas to simplify & solve problems **Analysis** Determine why the formula are not simply (sin(a+b) is not sin(a)+sin(b)) **Synthesis** Compute sum and difference, double angle, and half angle formulae Verify trigonometric equations **Evaluation** Evaluate harmonic motion as it applies to sound, light, and other real life events
Logs and Exponents	**CCSS: Mathematics** **CCSS: HS: Functions**	Logarithms and Exponents	**Knowledge**

	Interpreting Functions **HSF-IF.B. Interpret functions that arise in applications in terms of the context.** HSF-IF.B.4. 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. HSF-IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. **Building Functions** **HSF-BF.B. Build new functions from existing functions.** HSF-BF.B.4. Find inverse functions. HSF-BF.B.4b. (+) Verify by composition that one function is the inverse of another. HSF-BF.B.4d. (+) Produce an invertible function from a non-invertible function by restricting the domain. HSF-BF.B.5. (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. 	- Graphing - Compound Interest - Solving and simplifying	State the value of e. **Application** Graph logarithmic and exponential functions. Simplify and solve logarithmic and exponential expressions and equations. **Evaluation** Use compound interest formulas to aid in decision making regarding loans, saving money, etc.
Conic Sections	**CCSS: Mathematics** **CCSS: HS: Geometry** **Expressing Geometric Properties with Equations**	Conics -Parabolas	**The students will be able to:**

	HSG-GPE.A. Translate between the geometric description and the equation for a conic section HSG-GPE.A.2. Derive the equation of a parabola given a focus and directrix. HSG-GPE.A.3. (+) Derive the equations of ellipses and hyperbolas given two foci for the ellipse, and two directrices of a hyperbola. 	-Circles -Ellipses -Hyperbolas	**Knowledge** Identify types of conic sections by their equations. **Application** Graph conic sections using critical points and x and y-axes. Write equations of conic sections.
Limits	**AP: Calculus AB & BC (2020)** **AP: AP** **UNIT 1 Limits and Continuity** **TOPIC 1.2 Defining Limits and Using Limit Notation** **LIM-1 Reasoning with definitions, theorems, and properties can be used to justify claims about limits.** LIM-1.A Represent limits analytically using correct notation. LIM-1.A.1 Given a function f, the limit of f(x) as x approaches c is a real number R if f(x) can be made arbitrarily close to R by taking x suficiently close to c (but not equal to c). If the	-Finding Limits Numerically -Finding Limits Graphically -Finding Limits Analytically/Algebraically • Absolute Value • One-Sided -Continuity - Definition of derivative	**Knowledge** State the definition of limit. **Comprehension** Determine limits by looking at a graph. **Application**

	limit exists and is a real number, then the common notation is $\lim_{x \to c} f(x) = R$ LIM-1.B.1 A limit can be expressed in multiple ways, including graphically, numerically, and analytically **TOPIC 1.3 Estimating Limit Values from Graphs** **LIM-1 Reasoning with definitions, theorems, and properties can be used to justify claims about limits.** LIM-1.C.1 The concept of a limit includes one sided limits. AP Frameworks	-Limits at Infinity • Horizontal Asymptotes • Vertical Asymptotes	Solve limit problems from graphs and data tables on a calculator. Solve limit problems algebraically. **Analysis** Calculate the first derivative of a function using the definition of derivative (limit as h approaches zero). **Evaluation** **Synthesis**
Final Exam			