Calculus II

Diocese of Greensburg Curriculum

Unit	Standards	Content	Skills
Integration	**CA: CCSS: Mathematics** **CA: Advanced Mathematics** **Calculus** **Calculus: When taught in high school, calculus should be presented with the same level of depth and rigor as are entry-level college and university calculus courses. These standards outline a complete college curriculum in one variable calculus. Many high school programs may have insufficient time to cover all of the following content in a typical academic year. For example, some districts may treat differential equations lightly and spend substantial time on infinite sequences and series. Others may do the opposite. Consideration of the College Board syllabi for the Calculus AB and Calculus BC sections of the Advanced Placement Examination in Mathematics may be helpful in making curricular decisions. Calculus is a widely applied area of mathematics and involves a beautiful intrinsic theory. Students mastering this content will be exposed to both aspects of the subject.** 16.0 Students use definite integrals in problems involving area, velocity, acceleration, volume of a solid, area of a surface of revolution, length of a curve, and work. 17.0 Students compute, by hand, the integrals of a wide variety of functions by using techniques of integration, such as substitution, integration by parts, and trigonometric substitution. They can also combine these techniques when appropriate. 19.0 Students compute, by hand, the integrals of rational functions by combining the techniques in	• Substitution Rule • Integration by Parts • Trig Integrals and Substitution • Partial Fractions • Approximate Integration (Simpson's Rule) • Improper Integrals	• **Students will be able to:** **Knowledge** • evaluate indefinite and definite integrals. **Comprehension** • Understand the Fundamental Theorem of Calculus **Application** **Analysis** • evaluate the error in integral approximation **Synthesis**

	standard 17.0 with the algebraic techniques of partial fractions and completing the square. 21.0 Students understand the algorithms involved in Simpson's rule and Newton's method. They use calculators or computers or both to approximate integrals numerically. 22.0 Students understand improper integrals as limits of definite integrals © California Department of Education		**Evaluation** • **use the Comparison Theorem to determine convergence and divergence**

Applications of Integration		• Areas Between Curves
		• Volumes by Washers and Shells
		• Arc Length
		• Applications to Physics
		  ○ Force
		  ○ Work
		  ○ Center of Mass
			Students will be able to :
			
			Knowledge
			
			• Find the area of a region between two curves using integration.
			
			• Find the area of a region between intersecting curves using integration.
			
			Comprehension
			
			• Describe integration as an accumulation process.
			
			• Understand the definition of mass.
			
			Application
			
			• Find the volume of a solid of revolution using the disk method.

			• Find the volume of a solid of revolution using the washer method. • Find the volume of a solid with known cross sections. • Find the volume of a solid of revolution using the shell method. • Find the arc length of a smooth curve. • Find the area of a surface of revolution. • Find the work done by a constant force. • Find the work done by a variable force. **Analysis** • Compare the uses of the disk method and the shell method. **Synthesis** **Evaluation**

Sequences and Series	**CA: CCSS: Mathematics** **CA: Advanced Mathematics** **Calculus** **Calculus: When taught in high school, calculus should be presented with the same level of depth and rigor as are entry-level college and university calculus courses. These standards outline a complete college curriculum in one variable calculus. Many high school programs may have insufficient time to cover all of the following content in a typical academic year. For example, some districts may treat differential equations lightly and spend substantial time on infinite sequences and series. Others may do the opposite. Consideration of the College Board syllabi for the Calculus AB and Calculus BC sections of the Advanced Placement Examination in Mathematics may be helpful in making curricular decisions. Calculus is a widely applied area of mathematics and involves a beautiful intrinsic theory. Students mastering this content will be exposed to both aspects of the subject.** 23.0 Students demonstrate an understanding of the definitions of convergence and divergence of sequences and series of real numbers. By using such tests as the comparison test, ratio test, and alternate series test, they can determine whether a series converges. 24.0 Students understand and can compute the radius (interval) of the convergence of power series. 25.0 Students differentiate and integrate the terms of a power series in order to form new series from known ones.	• Sequences • Series • Integral Test • Comparison Test • Alternating Series Test • Absolute Convergence • Ratio Test • Root Test • Power Series • Representing Functions as Power Series • Taylor and Maclaurin Series • Applications of Taylor Polynomials 09.02 Series and Convergence.pptx 09.03 The Integral Test and p-Series.pptx 09.04 Comparisons of Series and Alternating Series.pptx 09.06 The Ratio and Root Tests.pptx	**Students will be able to :** **Knowledge** • Identify whether a sequence is Geometric, Harmonic, P-Series, Alternating Series, Power Series, Taylor Series, and Maclaurin Series **Comprehension** • Determine whether a sequence in convergent or divergent **Application** • will use the Divergence Test, Comparison Test, Limit Comparison Test, Ratio Test, and Root Test to find the convergence and divergence **Analysis**

	26.0 Students calculate Taylor polynomials and Taylor series of basic functions, including the remainder term. © California Department of Education		• Evaluate if whether a limit of the sequence exists **Synthesis** **Evaluation**
Midterm			

Parametric and Polar Curves		• Parametric Curves
		• Calculus with Parametric Curves
		  ○ First and Second Derivatives
		  ○ Tangents
		  ○ Area
		  ○ Arc Length
		• Polar Curves
		• Calculus with Polar Curves
			Students will be able to:
			
			Knowledge
			
			• Convert between Cartesian coordinates and Polar Coordinates
			• Convert between Cartesian equations and Polar equations
			• Identify various Polar Curves
			
			Comprehension

			Application • Find areas and length in polar coordinates • Graph Polar Coordinates using appropriate mathematical tools (Graphing Calculator, Desmos,....) **Analysis** **Synthesis** • Create a design using Polar Curves **Evaluation**
Vectors		• Magnitude • Direction • Graphing • Functions • Normal Vectors • Dot Product • Cross Product	**Knowledge** **Comprehension**

			Application **Analysis** **Synthesis** **Evaluation** Students will evaluate incorrect work for errors.
Differential Equations	**AP: Calculus AB & BC (2020)** **AP: AP** **UNIT 7 Differential Equations** **BIG IDEA 3 Analysis of Functions FUN** How can we derive a model for the number of computers, C, infected by a virus, given a model for how fast the computers are being infected, $\frac{d(C)}{dt}$, at a particular time? **TOPIC 7.1 Modeling Situations with Differential Equations** **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.A Interpret verbal statements of problems as differential equations involving a derivative expression.	• Separable Differential Equations • First-Order Linear Differential Equations • Homogeneous Second Order Linear Differential Equations • Nonhomogeneous Second Order Linear Differential Equations • Applications of Second Order Linear Differential Equations 06.01 Slope Fields and Euler's Method.pptx 06.02 Differential Equations.pptx 06.03 Separation of Variables	**Knowledge** **Comprehension** **Application**

	FUN-7.A.1 Differential equations relate a function of an independent variable and the function's derivatives. **TOPIC 7.2 Verifying Solutions for Differential Equations** **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.B Verify solutions to differential equations. FUN-7.B.1 Derivatives can be used to verify that a function is a solution to a given differential equation. FUN-7.B.2 There may be infinitely many general solutions to a differential equation. **TOPIC 7.3 Sketching Slope Fields** **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.C Estimate solutions to differential equations. FUN-7.C.1 A slope field is a graphical representation of a differential equation on a finite set of points in the plane. FUN-7.C.2 Slope fields provide information about the behavior of solutions to first-order differential equations.	and the Logistic Equation.pptx 06.04 First-Order Linear Differential Equations.pptx	**Analysis** **Synthesis** **Evaluation** Students will evaluate incorrect work for errors.

	TOPIC 7.4 Reasoning Using Slope Fields **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.C Estimate solutions to differential equations. FUN-7.C.3 Solutions to differential equations are functions or families of functions. **TOPIC 7.5 Approximating Solutions Using Euler's Method BC only** **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.C Estimate solutions to differential equations. FUN-7.C.4 Euler's method provides a procedure for approximating a solution to a differential equation or a point on a solution curve. BC only **TOPIC 7.6 Finding General Solutions Using Separation of Variables** **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.D Determine general solutions to differential equations. FUN-7.D.1 Some differential equations can be solved by separation of variables. FUN-7.D.2 Antidifferentiation can be used to find general solutions to differential equations.		

	TOPIC 7.7 Finding Particular Solutions Using Initial Conditions and Separation of Variables **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.E Determine particular solutions to differential equations. FUN-7.E.1 A general solution may describe infinitely many solutions to a differential equation. There is only one particular solution passing through a given point. FUN-7.E.2 The function F defined by $F(x) = y_0 + \int_a^x f(t)dt$ is a particular solution to the differential equation $\frac{dy}{dx} = f(x)$, satisfying $F(a) = y_0$. **TOPIC 7.8 Exponential Models with Differential Equations** **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.F Interpret the meaning of a differential equation and its variables in context. FUN-7.G Determine general and particular solutions for problems involving differential equations in context. FUN-7.F.1 Specific applications of finding general and particular solutions to differential equations include motion along a line and exponential growth and decay.		

	FUN-7.F.2 The model for exponential growth and decay that arises from the statement “The rate of change of a quantity is proportional to the size of the quantity” is $\frac{dy}{dt} = ky$. FUN-7.G.1 The exponential growth and decay model, $\frac{dy}{dt} = ky$, with initial condition $y = y_0$ when t = 0, has solutions of the form $y = y_0e^{kt}$. **TOPIC 7.9 Logistic Models with Differential Equations BC only** **FUN-7 Solving differential equations allows us to determine functions and develop models.** FUN-7.H Interpret the meaning of the logistic growth model in context. BC only FUN-7.H.1 The model for logistic growth that arises from the statement “The rate of change of a quantity is jointly proportional to the size of the quantity and the difference between the quantity and the carrying capacity” is $\frac{dy}{dt} = ky(a - y)$. BC only FUN-7.H.2 The logistic differential equation and initial conditions can be interpreted without solving the differential equation. BC only FUN-7.H.3 The limiting value (carrying capacity) of a logistic differential equation as the independent variable approaches infinity can be determined using the logistic growth model and initial conditions. BC only		

	FUN-7.H.4 The value of the dependent variable in a logistic differential equation at the point when it is changing fastest can be determined using the logistic growth model and initial conditions. BC only © 2013 The College Board, Advanced Placement AP Frameworks		
Partial Derivatives *optional*			
Final			