

Mathematics – PLANNED COURSE OUTLINE

Avon Grove School District

Grade 11 – AP Calculus

State Benchmarks (K,3,5,8,11) & Grade Specific Benchmark	Eligible Content	The Learner will be able to;	Instructional Strategies, Resources and Assessments
Standard: 2.2. Computation and Estimation			
Enduring Understandings: Students will understand that: 1. Knowing the reasonableness of an answer comes from using good number sense and estimation strategies.		Essential Questions: 1. What makes an estimate reasonable?	
A. Develop and use computation concepts, operations and procedures with real numbers in problem-solving situations. Numbers and Operations M11.A M11.A.2 Understand the meanings of operations use operations and understand how they relate to each other. M11.A.2.1 Apply ratio and/or proportion in problem-solving situations. M11.A.3 Compute accurately and fluently and make reasonable estimates. M11.A.3.1 Apply the order of operations in computation and in problem-solving situations.	Solve problems using operations with rational numbers including rates and percents (single and multi-step and multiple procedure operations) (e.g., distance, work and mixture problems, etc.). (2.2.11.A) M11.A.2.1.1 Simplify/evaluate expressions using the order of operations to solve problems (any rational numbers may be used). (2.2.8.A) M11.A.3.1.1	<ul style="list-style-type: none"> Solve related rate and optimization word problems (Ch #4) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made
B. Demonstrate skills for using computer spreadsheets and scientific and graphing calculators.		<ul style="list-style-type: none"> Use the graphing calculator to determine derivatives and integrals (Ch #4 – Ch #7) 	

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Standard: 2.3. Measurement and Estimation			
Enduring Understandings: Students will understand that: <ul style="list-style-type: none"> • Mathematics can be used to solve problems outside of the mathematics classroom. • All measurements are approximations and the precision of the measurement depends on the tool and unit used. • Understand measurable attributes of objects and the units, systems, and processes of measurement. 		Essential Questions: <ol style="list-style-type: none"> 1. Is your plan working? Should you try a different method? 2. How does what we measure affect how we measure? 	
A. Select and use appropriate units and tools to measure to the degree of accuracy required in particular measurement situations. M11.B Measurement M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements. M11.B.2.1 Use and/or compare measurements of angles. M11.B.2.2 Use and/or develop procedures to determine or describe measures of perimeter, circumference, area, surface area and/or volume. (May require conversions within the same system.)	Measure and/or compare angles in degrees (up to 360°) (protractor must be provided or drawn). (2.3.11.A & 2.3.11.B) M11.B.2.1.1 Calculate the surface area of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet. (2.3.8.A & 2.3.8.D) M11.B.2.2.1 Calculate the volume of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet. (2.3.8.A & 2.3.8.D) M11.B.2.2.2 Estimate area, perimeter or circumference of an irregular figure. (2.3.8.A & 2.3.8.D) M11.B.2.2.3 Find the measurement of a missing length given the perimeter, circumference, area or volume. (2.3.8.A & 2.3.8.D) M11.B.2.2.4	<ul style="list-style-type: none"> • Find the volume of different geometric solids using integration. (Ch #7) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Standard: 2.3. Measurement and Estimation			
<p>B. Describe how a change in linear dimension in a object affects its perimeter, area and volume (Grade 8)</p> <p>M11.B Measurement</p> <p>M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.</p> <p>M11.B.2.3 Describe how a change in one dimension of a figure (2 or 3 dimensional) affects other measurements of that figure.</p>	<p>Describe how a change in the linear dimension of a figure affects its perimeter, circumference, area or volume. (2.3.8.E) M11.B.2.3.1</p> <ol style="list-style-type: none"> 1. How does changing the length of the radius of a circle affect the circumference of the circle? 2. How does changing the length of the edge of a cube affect the volume of the cube? 3. How does changing the length of the base of a triangle affect the area of the triangle? 	<ul style="list-style-type: none"> • Related Rates (4.6) 	<p>Instructional Strategies:</p> <ul style="list-style-type: none"> Guided Practice Lecture Projects Group Work Discussion Independent Practice <p>Resources:</p> <ul style="list-style-type: none"> Textbook Publisher made supplemental materials Teacher made supplemental materials <p>Assessments:</p> <ul style="list-style-type: none"> Publisher made Teacher made

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Standard: 2.4. Mathematical Reasoning and Connections			
Enduring Understandings: Students will understand that: <ul style="list-style-type: none"> • Reasoning allows us to make conjectures and prove conjectures. • Precise language helps us express mathematical ideas and receive them. • Connections can be made to various strands of mathematics as well as other subject areas. • Understand how mathematical ideas interconnect and build on one another to produce a coherent whole. 		Essential Questions: <ol style="list-style-type: none"> 1. How are solving and proving different? 2. How are showing and explaining different? 3. How do you know when you have proven something? 4. How do you develop a convincing argument? 5. What previous learning helps us to learn new materials? 6. What makes a strategy both effective and efficient? 7. _Need to add ?s on Connections_____ 	
A. Demonstrate mathematical solutions to problems (e.g., in the physical sciences).		<ul style="list-style-type: none"> • Use calculus to answer Physics problems (Throughout the course) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Standard: 2.6. Statistics and Data Analysis			
Enduring Understandings: Students will understand that: <ul style="list-style-type: none"> • The question to be answered determines the data to be collected and how best to collect it. • Basic statistical techniques can be used to analyze data in the work place. • The probability of an event can be used to predict the probability of future events. • The study of statistics allows us to interpret and analyze data in order to make informed decisions. • The type of data determines how data sets can be organized, displayed, and analyzed. • Calculating the mean, median, mode, and range creates a numerical picture of data. 		Essential Questions: <ol style="list-style-type: none"> 1. What is average? 2. What makes a data representation useful? 3. How does my sample affect confidence in my prediction? 4. What is random? 5. How can we use data to make informed decisions? 6. How does the type of data influence the type of graph? 7. How can mean, median, mode, and range be used to describe the shape of data? 8. In what ways can data and data displays be misleading? 	
A. Determine the regression equation of best fit (e.g., linear, quadratic, exponential). M11.E Data Analysis and Probability M11.E.4 Develop and/or evaluate inferences and predictions or draw conclusions based on data or data displays. M11.E.4.2 Analyze and/or interpret data on a scatter plot and/or use a scatter plot to make predictions.	Draw, find and/or write an equation for a line of best fit for a scatter plot. (2.6.11.C) M11.E.4.2.1	<ul style="list-style-type: none"> • Calculate and interpret a regression line for different types of data. (Ch #1) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Standard: 2.6. Statistics and Data Analysis			
<p>B. Make predictions using interpolation, extrapolation, regression and estimation using technology to verify them.</p> <p>M11.E Data Analysis and Probability</p> <p>M11.E.4 Develop and/or evaluate inferences and predictions or draw conclusions based on data or data displays</p> <p>M11.E.4.1 Make predictions using data displays and probability.</p> <p>M11.E.4.2 Analyze and/or interpret data on a scatter plot and/or use a scatter plot to make predictions.</p>	<p>Use probability to predict outcomes. (References 2.6.11.D) M11.E.4.1.2</p> <p>Make predictions using the equations or graphs of best-fit lines of scatter plots. (References 2.6.11.D) M11.E.4.2.2</p>	<ul style="list-style-type: none"> • Make predictions with lines of best fit (1.2) 	<p>Instructional Strategies:</p> <ul style="list-style-type: none"> Guided Practice Lecture Projects Group Work Discussion Independent Practice <p>Resources:</p> <ul style="list-style-type: none"> Textbook Publisher made supplemental materials Teacher made supplemental materials <p>Assessments:</p> <ul style="list-style-type: none"> Publisher made Teacher made

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Standard: 2.8. Algebra and Functions			
Enduring Understandings: Students will understand that: <ul style="list-style-type: none"> • Change is fundamental to understanding functions. • Numbers or objects that repeat in predicable ways can be described or generalized. • An operation can be undone by its inverse. • Rules of arithmetic and algebra can be used together with notions of equivalents to transform equations and inequalities so solutions can be found. • Mathematical situations can be represented using patterns, symbols, and rules to describe relationships. • Algebra solves real life problems when numbers are unknown. 		Essential Questions: <ol style="list-style-type: none"> 1. How can change be described mathematically? 2. How are patterns of change related to the behavior of functions? 3. How do mathematical models/representations shape our understanding of mathematics? 4. How can we use patterns, symbols, and rules to represent and describe mathematical relationships? 	
A. Analyze a given set of data for the existence of a pattern and represent the pattern algebraically and graphically. M11.D Algebraic Concepts M11.D.1 Demonstrate an understanding of patterns, relations and functions. M11.D.1.1 Analyze and/or use patterns or relations.	Determine if a relation is a function given a set of points or a graph. (2.8.11.A) M11.D.1.1.2	<ul style="list-style-type: none"> • Use the vertical line test to determine if a relation is a function (1.2) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials
B. Formulate expressions, equations, inequalities, systems of equations, systems of inequalities and matrices to model routine and non-routine problem situations. M11.D Algebraic Concepts M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs. M11.D.2.1 Write, solve and/or graph linear equations and inequalities using various methods.	Identify or graph functions, linear equations or linear inequalities on a coordinate plane. (2.8.11.D) M11.D.2.1.	<ul style="list-style-type: none"> • Graph 9 key functions by hand and on the graphing calculator (Ch #1) 	Assessments: Publisher made Teacher made

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Standard: 2.8. Algebra and Functions			
<p>C. Demonstrate the connection between algebraic equations and inequalities and the geometry of relations in the coordinate plane.</p> <p>M11.D Algebraic Concepts</p> <p>M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.</p> <p>M11.D.2.1 Write, solve and/or graph linear equations and inequalities using various methods.</p> <p>M11.D.3 Analyze change in various contexts.</p> <p>M11.D.3.1 Describe and/or determine change.</p> <p>M11.D.3.2 Compute and/or use the slope of a line.</p>	<p>Identify or graph functions, linear equations or linear inequalities on a coordinate plane. (2.8.11.J) M11.D.2.1.2</p> <p>Write and/or solve systems of equations using graphing, substitution and/or elimination (limit systems to 2 equations). (2.8.11.J) M11.D.2.1.4</p> <p>Identify, describe and/or use constant or varying rates of change. (2.8.8.J) M11.D.3.1.1</p> <p>Apply the formula for the slope of a line to solve problems (formula given on reference sheet). (2.8.11.J) M11.D.3.2.1</p>	<ul style="list-style-type: none"> • Determine derivatives using the definition of derivatives (3.1) 	<p>Instructional Strategies:</p> <p>Guided Practice Lecture Projects Group Work Discussion Independent Practice</p> <p>Resources:</p> <p>Textbook Publisher made supplemental materials Teacher made supplemental materials</p> <p>Assessments:</p> <p>Publisher made Teacher made</p>

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Standard: 2.8. Algebra and Functions			
<p>D. Select, justify and apply an appropriate technique to graph a linear function in two variables, including slope-intercept, x- and y-intercepts, graphing by transformations and the use of a graphing calculator.</p> <p>M11.D Algebraic Concepts</p> <p>M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.</p> <p>M11.D.2.1 Write, solve and/or graph linear equations and inequalities using various methods.</p> <p>M11.D.4 Describe or use models to represent quantitative relationships.</p> <p>M11.D.4.1 Interpret and/or use linear, quadratic and/or exponential functions and their equations, graphs or tables.</p>	<p>Write, solve and/or apply a linear equation (including problem situations). (2.8.11.K) M11.D.2.1.3</p> <p>Match the graph of a given function to its table or equation. (2.8.11.K, 2.8.11.Q) M11.D.4.1.1</p>	<ul style="list-style-type: none"> Find and interpret the equation of a tangent and normal line (Ch #4) Find the graph of a function given the graph of its derivative (4.3) 	<p>Instructional Strategies:</p> <p>Guided Practice Lecture Projects Group Work Discussion Independent Practice</p> <p>Resources:</p> <p>Textbook Publisher made supplemental materials Teacher made supplemental materials</p> <p>Assessments:</p> <p>Publisher made Teacher made</p>
<p>E. Write the equation of a line when given the graph of the line, two points on the line, or the slope of the line and a point on the line.</p> <p>M11.D Algebraic Concepts</p> <p>M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.</p> <p>M11.D.2.1 Write, solve and/or graph linear equations and inequalities using various methods.</p> <p>M11.D.3 Analyze change in various contexts.</p> <p>M11.D.3.2 Compute and/or use the slope of a line.</p>	<p>Write, solve and/or apply a linear equation (including problem situations). (2.8.11.L) M11.D.2.1.3</p> <p>Given the graph of the line, 2 points on the line, or the slope and a point on a line, write or identify the linear equation in point-slope, standard and/or slope-intercept form. (2.8.11.L) M11.D.3.2.2</p> <p>Compute the slope and/or y-intercept represented by a linear equation or graph. (2.8.11.L) M11.D.3.2.3</p>	<ul style="list-style-type: none"> Calculate the slope of the a line given two points(1.1) Find the equation of a line given a point and a line parallel or perpendicular (1.1) Calculate the slope of the a line given two points (1.1) Find the equation of a line given a point and a line parallel or perpendicular (1.1) Find the equation of a tangent and normal line (2.4) 	

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Standard: 2.8. Algebra and Functions			
F. Solve linear, quadratic and exponential equations both symbolically and graphically.		<ul style="list-style-type: none"> Find the domain and range of a relation and a function(1.2) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made
G. Determine the domain and range of a relation, given a graph or set of ordered pairs. M11.D Algebraic Concepts M11.D.1 Demonstrate an understanding of patterns, relations and functions. M11.D.1.1 Analyze and/or use patterns or relations.	Identify the domain, range or inverse of a relation (may be presented as ordered pairs or a table). (2.8.11.O) M11.D.1.1.3	<ul style="list-style-type: none"> Find the domain and range of a relation and a function(1.2) 	
H. Represent functional relationships in tables' charts and graphs. M11.D Algebraic Concepts M11.D.1 Demonstrate an understanding of patterns, relations and functions. M11.D.1.1 Analyze and/or use patterns or relations. M11.D.4 Describe or use models to represent quantitative relationships. M11.D.4.1 Interpret and/or use linear, quadratic and/or exponential functions and their equations, graphs or tables.	Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically. (2.8.11.Q) M11.D.1.1.1 Match the graph of a given function to its table or equation. (2.8.11.K, 2.8.11.Q) M11.D.4.1.1	<ul style="list-style-type: none"> Interpret a table of values to calculate the area under a curve (5.1) Interpret a table of values to calculate its rate of change (3.2) Determine a function given a graph of its derivative (4.3) 	

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Standard: 2.9. Geometry			
Enduring Understandings: Students will understand that: <ul style="list-style-type: none"> • Two- and three-dimensional objects can be described, classified, and analyzed by their attributes. • An object in a plane or in space can be oriented in an infinite number of ways while maintaining its size or shape. • An object’s location on a plane or in space can be described quantitatively. • Linear measure, area, and volume are fundamentally different but may be related to one another in ways that permit calculation of one given the other. • Reasoning allows us to make conjectures and prove conjectures. • Trigonometry is using the relationships between the sides and the angles of triangles to solve problems. 		Essential Questions: <ol style="list-style-type: none"> 1. How measurement and counting are related? 2. How does what we measure affect how we measure? 3. How can space be defined through numbers/measurement? 4. Why do we compare, contrast, and classify objects? 5. How do decomposing and recomposing shapes help us build our understanding of mathematics? 6. How can transformations be described mathematically? 7. How are solving and proving different? 8. How are showing and explaining different? 9. How do you know when you have proven something? 10. What is trigonometry? How does it help us? 	
A. Solve problems using analytic geometry. M11.C Geometry M11.C.3 Locate points or describe relationships using the coordinate plane. M11.C.3.1 Solve problems using analytic geometry.	Calculate the distance and/or mid-point between 2 points on a number line or on a coordinate plane (formula provided on the reference sheet). (2.9.11.G) M11.C.3.1.1 Relate slope to perpendicularity and/or parallelism (limit to linear algebraic expressions; slope formula provided on the reference sheet). (2.9.11.G) M11.C.3.1.2	<ul style="list-style-type: none"> • Calculate the slope of the a line given two points (1.1) • Find the equation of a line given a point and a line parallel or perpendicular (1.1) • Find the equation of a tangent and normal line (2.4) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Standard: 2.10. Trigonometry			
Enduring Understandings: Students will understand that: <ul style="list-style-type: none"> • Six trigonometric functions and their inverses. • Trig graphs have practical applications. • Identities are used to evaluate, simplify, and solve trigonometric expressions and equations. • The law of cosines and the law of sines can be used to find missing measures. • Complex numbers can be used to convert from rectangular to polar coordinates and vice versa. • Vectors are added and multiplied and this helps with mathematical calculations for engineering and physics. 		Essential Questions: <ol style="list-style-type: none"> 1. How is trigonometry used to find unknown values? 2. Why are certain values undefined for certain functions? 3. How can you compare the graphs of the sine, cosine, tangent functions and their inverses? 4. What approaches can be used to verify an identity? 5. What is the best approach? 6. How can you determine if a triangle had no solution, one solution, or two solutions? 7. How can you solve triangles using these laws? 8. Why is it important to understand complex numbers to understand polar coordinates? 9. Why can't physical models of vector quantities be represented by scalar quantities? 	
A. Use graphing calculators to display periodic and circular functions; describe properties of the graphs.		<ul style="list-style-type: none"> • Graph and interpret functions by hand and on the graphing calculator (Ch #1) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Standard: 2.11. Concepts of Calculus			
Enduring Understandings: Students will understand that: <ul style="list-style-type: none"> • Calculus would not be possible without the concept of the limit. • Calculus is the language of Physics. • The derivative is the instantaneous rate of change. • Optimization can be achieved through differentiation. • The first derivative determines increasing and decreasing and the second derivative determines concavity. • A definite integral is sum of infinite rectangles. • The Fundamental Theorem is used to evaluate integrals. • The definition of the derivative and the integral can be applied to logarithmic, exponential, and transcendental functions. 		Essential Questions: <ol style="list-style-type: none"> 1. Why is the limit necessary to determine continuity? 2. How is the limit used to determine asymptotes? 3. When does a limit not exist? 4. What is the difference between average and instantaneous velocity? 5. How can differentiation be used to determine the curvature of a graph? 6. What is the relationship between and integral and the are under a curve? 7. How is the area of a curve and total distance related? 8. How can the slope of a curve be computed with just one point? 	
A. Determine maximum and minimum values of a function over a specified interval.		<ul style="list-style-type: none"> • Calculate a maximum and minimum of a function using derivatives (Ch #4) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made
B. Interpret maximum and minimum values in problem situations.		<ul style="list-style-type: none"> • Use the first derivative test to calculate real world critical points (Ch #4) • Solve related rate word problems (Ch #4) • Solve optimization word problems (Ch #4) 	
C. Graph and interpret rates of growth/decay.		<ul style="list-style-type: none"> • Graph and interpret exponential functions (1.3) • Find derivatives of exponential functions (3.9) 	
D. Estimate areas under curves using sequences of areas.		<ul style="list-style-type: none"> • Find the area under a curve using Riemann Sum (5.1 & 5.2) • Find the area under a curve using integrals (Ch #5) 	

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