

Math Planned Course: Calculus 3 Multivariable – Grade 11, 12

Unit I: Conics, Parametric Equations, and Polar Coordinates

Content Standard: Understand that a conic section is defined as the intersection of a plane and a double napped cone. Understand that a parametric equation is comprised of three variables and two linear equations. Understand how to use calculus and parametric equations to solve problems. Understand the Polar Coordinate System and how to solve problems using polar functions.

State Curriculum Standard:

- 2.1 Numbers, Number Systems, and Number Relationships**
- 2.2 Computation and Estimation**
- 2.3 Measurement and Estimation**
- 2.4 Mathematical Reasoning and Connections**
- 2.5 Mathematical Problem Solving and Communications**
- 2.7 Probability and Prediction**
- 2.8 Algebra and Functions**
- 2.9 Geometry**
- 2.10 Trigonometry**
- 2.11 Concepts of Calculus**

ISTE's Educational Technology Standards *USED EVERYDAY*

- 1. Creativity and innovation**
- 2. Communication and collaboration**
- 3. Research and information fluency**
- 4. Critical thinking, problem solving, and decision making**
- 5. Digital citizenship**
- 6. Technology operations and concepts**

PSSA Anchor:

- M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.**
- M11.A.2 Understand meanings of operations, use operations and understand how they relate to each other.**
- M11.A.3 Compute accurately and fluently and make reasonable estimates.**
- M11.B.1 Demonstrate an understanding of measurable attributes of objects and figures, and units, systems and processes of measurement.**
- M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.**
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Pacing: 8 Days

Math Planned Course: Calculus 3 Multivariable – Grade 11, 12

Course Content	Student Performance	Resources	Assessments
<p>A. Conic Section</p> <p>B. Parametric Equations</p> <p>C. Polar Coordinates and Polar Graphs</p> <p>D. Kepler's Law</p>	<ul style="list-style-type: none"> • Use conic sections to find equations of parabolas, ellipses and hyperbolas • Graph parametric equations, find derivatives, arc length, and area of a surface of revolution using integration • Use coordinate conversions to graph polar functions • Find slope in polar form • Use integration to find area, arc length and area of surface of revolution • Use Kepler's Law to solve problems involving orbiting of planets 	<ul style="list-style-type: none"> • Graphing calculator • Computer graphing software • AP Calculus released exams • AP Calculus Website {www.collegeboard.com} • Calculus labs and student projects • PowerPoint presentations • Teacher's guide • Solution manual • APCD CD-Rom • Spreadsheet program • Geometer's sketchpad • United streaming 	<ul style="list-style-type: none"> • Explorations • Quizzes • Exams • Journal • Presentations • Research project • Cooperative learning

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Unit: **Vectors and the Geometry of Space**

Content Standard: **Understand Vectors in the Plane** including component form of a vector, vector operations, standard unit vector, and applications of vectors.

Understand how to find coordinates in space, dot products and cross products. Understand that cylindrical coordinates are an extension of polar coordinates.

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Pacing: **12 Days**

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Course Content	Student Performance	Resources	Assessments
<p>A. Vectors in a Plane</p> <p>B. Space Coordinates and Vectors in Space</p> <p>C. The Dot Product</p> <p>D. The Cross Product</p> <p>E. Lines and Planes in Space</p> <p>F. Surface in Space</p> <p>G. Cylindrical and Spherical Coordinates</p>	<ul style="list-style-type: none"> • Learn about the component form of a vector and apply what they learn to physic problems • Find distance and vectors in space and apply them to force problems • Find the dot product of, angle between, force of, and work done of two vectors • Apply algebraic and geometric properties of the cross product to solve force problems • Learn how to use triple scalar products • Find equation of line in three-space • Find distance between a point and plane, between two parallel planes, and point and a line in space • Find surface equations of 3 dimensional figures • Apply knowledge about polar coordinates and adapt to cylindrical and spherical 	<ul style="list-style-type: none"> • Graphing calculator • Computer graphing software • AP Calculus released exams • AP Calculus Website {www.collegeboard.com} • Calculus labs and student projects • PowerPoint presentations • Teacher's guide • Solution manual • APCD CD-Rom • Spreadsheet program • Geometer's sketchpad • United streaming 	<ul style="list-style-type: none"> • Explorations • Quizzes • Exams • Journal • Presentations • Research project • Cooperative learning

Math Planned Course: Calculus 3 Multivariable – Grade 11, 12

	coordinates		
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Unit: **Vector-Valued Functions**

Content Standard: **A vector-valued function is a function that maps real numbers onto vectors.**

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Math Planned Course: Calculus 3 Multivariable – Grade 11, 12

Course Content	Student Performance	Resources	Assessments
<p>A. Vector-Valued Functions</p> <p>B. Differentiation and Integration of Vector-Valued Functions</p> <p>C. Velocity and Acceleration</p> <p>D. Tangent Vectors and Normal Vectors</p> <p>E. Arc Length and Curvature</p>	<ul style="list-style-type: none"> • Graph and solve problems using definition of vector-valued functions • Differentiate and integrate vector-valued functions • Find velocity and acceleration of vector-valued functions including projectile motion • Find tangent and normal vectors and apply them to projectile motion • Find arc length and curvature of vector-valued functions 	<ul style="list-style-type: none"> • Graphing calculator • Computer graphing software • AP Calculus released exams • AP Calculus Website {www.collegeboard.com} • Calculus labs and student projects • PowerPoint presentations • Teacher's guide • Solution manual • APCD CD-Rom • Spreadsheet program • Geometer's sketchpad • United streaming 	<ul style="list-style-type: none"> • Explorations • Quizzes • Exams • Journal • Presentations • Research project • Cooperative learning

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Unit: Functions of Several Variables

Content Standard: Functions of several variable deal with two or more variables and will be in the form of $f(x,y)$ or $f(x,y,z)$.

State Curriculum Standard:

- 2.1 Numbers, Number Systems, and Number Relationships
- 2.2 Computation and Estimation
- 2.3 Measurement and Estimation
- 2.4 Mathematical Reasoning and Connections
- 2.5 Mathematical Problem Solving and Communications
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Pacing: 16 Days

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Course Content	Student Performance	Resources	Assessments
A. Introduction to Functions of Several Variables	<ul style="list-style-type: none"> Learn what functions of several variables are about and be able to sketch their curves 	<ul style="list-style-type: none"> Graphing calculator Computer graphing software AP Calculus released exams AP Calculus Website {www.collegeboard.com} Calculus labs and student projects PowerPoint presentations Teacher's guide Solution manual APCD CD-Rom Spreadsheet program Geometer's sketchpad United streaming 	<ul style="list-style-type: none"> Explorations Quizzes Exams Journal Presentations Research project Cooperative learning
B. Limits & Continuity	<ul style="list-style-type: none"> Find the limit and continuity of functions of two and three variables 		
C. Partial Derivatives	<ul style="list-style-type: none"> Use the definition of partial derivatives to solve problems 		
D. Differentials	<ul style="list-style-type: none"> Find differentials and use them to find an approximation for the value of a function 		
E. Chain Rule	<ul style="list-style-type: none"> Solve related rate problems using chain rule Find partial derivative implicitly 		
F. Directional Derivatives and Gradients	<ul style="list-style-type: none"> Determine slope at point on surface by using directional derivatives and gradients 		
G. Tangent Planes and Normal Lines	<ul style="list-style-type: none"> Find equation of tangent plane 		
H. Extrema of Functions	<ul style="list-style-type: none"> Find max, min, critical points, and use second partials test 		

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Course Content	Student Performance	Resources	Assessments
I. Applications of Extrema of Functions of Two Variables J. Lagrange Multipliers	<ul style="list-style-type: none">• Solve real word problems using optimization techniques and method of least squares• Apply constraints to optimization problems		

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Unit: **Multiple Integration**

Content Standard: **Multiple integration is taking the integral of several different variables**

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A. Iterated Integrals & Area in the Plane	<ul style="list-style-type: none"> Integrate with several variables and find the area between two line using several variables 	<ul style="list-style-type: none"> Graphing calculator Computer graphing software AP Calculus released exams AP Calculus Website {www.collegeboard.com} Calculus labs and student projects PowerPoint presentations Teacher's guide Solution manual APCD CD-Rom Spreadsheet program Geometer's sketchpad United streaming 	<ul style="list-style-type: none"> Explorations Quizzes Exams Journal Presentations Research project Cooperative learning
B. Double Integrals & Volume	<ul style="list-style-type: none"> Evaluate double integrals and apply them to volume problems 		
C. Change of Variables: Polar Coordinates	<ul style="list-style-type: none"> Describe a region using polar coordinates and evaluate a double polar integral 		
D. Center of Mass and Moments of Inertia	<ul style="list-style-type: none"> Find center of mass and moments of inertia of Planar Laminas, Polar Coordinates 		
E. Surface Area	<ul style="list-style-type: none"> Find surface area using double integrals 		
F. Triple Integrals and Applications	<ul style="list-style-type: none"> Find volume, limits, center of mass and moments of inertia using triple integrals 		
G. Triple Integrals in Cylindrical and Spherical Coordinates	<ul style="list-style-type: none"> Find volume, limits, center of mass and moments of inertia using cylindrical coordinates 		
H. Change of Variables: Jacobians	<ul style="list-style-type: none"> Learn and apply Jacobians to change of variables for double integrals 		

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Unit: **Vector Analysis**

Content Standard: **Vector analysis involves vector fields including force fields and velocity fields.**

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A. Vector Fields	<ul style="list-style-type: none"> Learn about a variety of vector fields and how to sketch them 	<ul style="list-style-type: none"> Graphing calculator Computer graphing software 	<ul style="list-style-type: none"> Explorations Quizzes
B. Line Integrals	<ul style="list-style-type: none"> Integrate piecewise smooth curves and find the mass of a spring, work done by a force, and orientation of a curve 	<ul style="list-style-type: none"> AP Calculus released exams AP Calculus Website {www.collegeboard.com} 	<ul style="list-style-type: none"> Exams Journal Presentations
C. Conservative Vector Fields and Independence of Path	<ul style="list-style-type: none"> Learn the Fundamental Theorem of Line integrals 	<ul style="list-style-type: none"> Calculus labs and student projects 	<ul style="list-style-type: none"> Research project
D. Green's Theorem	<ul style="list-style-type: none"> Learn/apply Green's Theorem to variety of calculus problems 	<ul style="list-style-type: none"> PowerPoint presentations Teacher's guide 	<ul style="list-style-type: none"> Cooperative learning
E. Parametric Surface	<ul style="list-style-type: none"> Sketch and revolve parametric surfaces to find surface area 	<ul style="list-style-type: none"> Solution manual APCD CD-Rom 	
F. Surface Integrals	<ul style="list-style-type: none"> Evaluate surface integral and find its center of mass and orientation 	<ul style="list-style-type: none"> Spreadsheet program Geometer's sketchpad 	
G. Divergence Theorem	<ul style="list-style-type: none"> Learn/apply Divergence Theorem 	<ul style="list-style-type: none"> United streaming 	
H. Stoke's Theorem	<ul style="list-style-type: none"> Learn/apply Stoke's Theorem 		

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Unit: Differential Equations

Content Standard: **Differential equations are equations involving the derivatives of a function or functions.**

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Pacing: **10 Days**

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Course Content	Student Performance	Resources	Assessments
<p>A. Exact First-Order Equations</p> <p>B. First-Order Linear Differential Equations</p> <p>C. Second-Order Homogeneous Linear Equations</p> <p>D. Second-Order Non-Homogeneous Linear Equations</p> <p>E. Series Solutions of Differential Equations</p>	<ul style="list-style-type: none"> • Solve Exact Differential Equations • Solve first-order linear equations • Learn what second-order homogenous equations are apply them to the real world • Learn what second-order non-homogenous equations are and apply them to the real world • Find solutions to power series and Taylor series 	<ul style="list-style-type: none"> • Graphing calculator • Computer graphing software • AP Calculus released exams • AP Calculus Website {www.collegeboard.com} • Calculus labs and student projects • PowerPoint presentations • Teacher's guide • Solution manual • APCD CD-Rom • Spreadsheet program • Geometer's sketchpad • United streaming 	<ul style="list-style-type: none"> • Explorations • Quizzes • Exams • Journal • Presentations • Research project • Cooperative learning