

Pascack Valley Regional High School District

**Pascack Hills High School, Montvale, New Jersey
Pascack Valley High School, Hillsdale, New Jersey**

Course Name: Advanced Topics in Calculus

Born On: August, 2018
Previous Revision: August, 2020
Current Revision: August, 2023
Board Approval: 8/28/23

COURSE DESCRIPTION: Advanced Topics in Calculus

This full-year course will extend key ideas of one-variable calculus to functions with several variables. Topics will include the three-dimensional coordinate system, vectors, equations of lines, planes, cylinders, and quadric surfaces in three-dimensional space, vector functions and their applications to arc length, curvature, and motion in space, partial derivatives, multiple integrals, and theorems of vector calculus. Applications of these concepts will be a critical component of this course. 11th and 12th grade students enrolled in Advanced Topics in Calculus have the option of earning college credit by registering with William Paterson University at a reduced price but at student expense. Please note that dual enrollment is not required, and that the course will have the same requirements and expectations whether or not students elect to register for college credit.

All mathematics courses in the Pascack Valley Regional High School District are designed to address multiple learning styles and needs, and accommodations and modifications are made for students with disabilities, multilingual students, students at risk of failure, gifted and talented students, and students with 504 plans. *Advanced Topics in Calculus* builds on concepts learned and skills developed in *AP Calculus*, while also spiraling in those concepts and skills to reinforce and strengthen students' algebraic foundation. Additionally, *Advanced Topics in Calculus* anticipates higher-level mathematics that will be learned in college-level calculus courses, and enrichment opportunities are provided to challenge students and engage them in rich, interesting mathematics. Students are encouraged to analyze data using tools and models to make valid and reliable claims (9.4.12.IML.3), and various technologies are integrated throughout the curriculum, including scientific calculators, graphing calculators, specialized software, and various Internet programs and subscriptions. These tools enrich the curriculum by giving students' access to additional mathematical representations, and they also help to differentiate by providing students with additional options to engage with mathematical tasks.

The Pascack Valley Regional High School Mathematics Department integrates 21st century life and career skills across its courses, with the dual goal of informing students about careers and fields of study that use mathematics (9.3.ST.5, 9.3.ST-ET.5 and 9.3.ST-SM.2), and helping students improve the quantitative, mathematical, and statistical reasoning skills they will need to be effective producers and consumers of quantitative information in their everyday lives (9.2.12.CAP.2). Mathematics courses address the *New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills*, with a particular emphasis on demonstrating the ability to reflect, analyze and use creative skills and ideas (9.4.12.CI.1), investigating new challenges and opportunities for personal growth, advancement and transition (9.4.12.CI.3), identifying problem-solving strategies used in the development of an innovative product or practice (9.4.12.CT.1), and explaining the potential benefits of collaborating to enhance critical thinking and problem solving (9.4.12.CT.2). Mathematics courses also address the *New Jersey Student Learning Standards for English Language Arts Companion Standards*, with a particular focus on following complex multistep procedures (RST.9-10.3/RST.11-12.3), determining the meaning of symbols, key terms, and other domain-specific words and phrases (RST.9-10.4/RST.11-12.3), and translating quantitative or technical information expressed in words into visual forms and translating information expressed visually or mathematically into words (RST.9-10.7). Similarly, the mathematics department seeks to support students by providing them with opportunities to use quantitative, statistical, and mathematical reasoning in interdisciplinary contexts, in contexts that are meaningful to students, and in contexts that attend to the contributions and perspectives of historically marginalized groups. Specifically, mathematics courses will look to incorporate, when appropriate, contributions and experiences of people from the LGBTQ+ community and individuals with disabilities, and references to issues of social and cultural relevance, including climate change.

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Content/Topic:	Key Learning Items/Concepts and Pacing Guide	NJSLs	Formative, Summative, Benchmark, and Alternative Assessments	Core Instructional and Supplemental Materials/ Modifications and Accommodations
<p>Unit 1 – Additional Integration Techniques</p> <p>Time: 3 weeks</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - INT-1 Hyperbolic Functions (Larson 5.10) (1 week) - INT-2 Trigonometric Integrals (Larson 7.3) (1 week) - INT-3 Integration by Trigonometric Substitution (Larson 7.4) (1 week) <p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - Multiple representations will be incorporated to support conceptual understanding - Integrals of differing difficulty levels will be presented <p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - Applications from science and engineering will be included, when appropriate 	<p>NJSLS SMP</p> <p>MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLS for ELA Companion Standards</p> <p>RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life and Careers</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Benchmark assessments (B) - take home investigations (F) - graphing calculator assignments (F) - Sketchpad assignments and Calculus-in-motion labs (F) - alternative assessments (A) - integral problem sets (F) 	<p>Selection of primary sources <i>Suggestion(s):</i> Texts: Larson text; Stewart text; Deltamath (remediation, on grade level, and advanced)</p> <p>Graphic organizers available in teacher shared folders</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students’ IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed. Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling. Gifted and Talented Students: Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>

		9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2 - Technology 9.4.12.IML.3 - Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2 NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2		
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<p>Unit 2 – Vectors and the Geometry of Space</p> <p>Time: 5 weeks</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - VEC-1 Three-Dimensional Coordinate Systems (Stewart 12.1) (1/2 week) - VEC-2 Vectors (Stewart 12.2); Physics Application – Forces (1 week) - VEC-3 The Dot Product (Stewart 12.3); Physics Application – Work (1 week) - VEC-4 The Cross Product (Stewart 12.4); Physics Application – Torque (1 week) - VEC-5 The Equations of Lines and Planes (Stewart 12.5) (1 week) - VEC-6 Cylinders and Quadric Surfaces (Stewart 12.6) (1/2 week) <p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - Technology will be incorporated to help students visualize three dimensions - Multiple representations will be incorporated to support conceptual understanding 	<p>NJSLS SMP</p> <p>MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLS for ELA Companion Standards</p> <p>RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life and Careers</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Benchmark assessments (B) - take home investigations (F) - graphing calculator assignments (F) - Sketchpad assignments and Calculus-in-motion labs (F) - alternative assessments (A) - dot/cross product problem sets (F) 	<p>Selection of primary sources <i>Suggestion(s):</i> Texts: Larson text; Stewart text; Deltamath (remediation, on grade level, and advanced)</p> <p>Graphic organizers available in teacher shared folders</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students’ IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed. Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling. Gifted and Talented Students: Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>

	<p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - This unit will incorporate Physics applications related to forces, work, and torque 	<p>9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		
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<p>Unit 3 – Vector Functions</p> <p>Time: 4 weeks</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - VECF-1 Vector Functions and Space Curves (Stewart 13.1) (1 week) - VECF-2 Derivatives and Integrals of Vector Functions (Stewart 13.2) (1 week) - VECF-3 Arc Length and Curvature (Stewart 13.3) (1 week) - VECF-4 Motion in Space: Velocity and Acceleration (Stewart 13.4); Physics Application - Kepler's Laws (1 week) <p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - Technology will be incorporated to help students visualize three dimensions - Multiple representations will be incorporated to support conceptual understanding <p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - This unit will incorporate Physics applications related to Kepler's Laws 	<p>NJSLS SMP</p> <p>MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLS for ELA Companion Standards</p> <p>RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLS-CLKS - 21st Century Life</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Benchmark assessments (B) - take home investigations (F) - graphing calculator assignments (F) - Sketchpad assignments and Calculus-in-motion labs (F) - alternative assessments (A) - problems sets to practice finding derivatives of vector functions (F) 	<p>Selection of primary sources <i>Suggestion(s):</i> Texts: Larson text; Stewart text; Deltamath (remediation, on grade level, and advanced)</p> <p>Graphic organizers available in teacher shared folders</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students' IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students' understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed. Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling. Gifted and Talented Students: Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of</p>

		<p>and Careers 9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		<p>concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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<p>Unit 4 – Partial Derivatives</p> <p>Time: 7 weeks</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - PD-1 Functions of Several Variables (Stewart 14.1) (1/2 week) - PD-2 Limits and Continuity (Stewart 14.2) (1/2 week) - PD-3 Partial Derivatives (Stewart 14.3) (1 week) - PD-4 Tangent Planes and Linear Approximations (Stewart 14.4) (1 week) - PD-5 The Chain Rule (Stewart 14.5) (1 week) - PD-6 Directional Derivatives and the Gradient Vector (Stewart 14.6) (1 week) - PD-7 Maximum and Minimum Values (Stewart 14.7) (1 week) - PD-8 Lagrange Multipliers (Stewart 14.8) (1 week) <p>Content-specific modifications and accommodations</p> <p>#TODO</p> <ul style="list-style-type: none"> - Scaffolding strategies will be utilized to support students' ability to find partial derivatives - Multiple representations will 	<p>NJSLs SMP</p> <p>MP1. Make sense of problems and persevere in solving them</p> <p>MP2. Construct viable arguments and critique the reasoning of others</p> <p>MP3. Reason abstractly and quantitatively</p> <p>MP4. Model with mathematics</p> <p>MP5. Attend to precision</p> <p>MP6. Use appropriate tools strategically</p> <p>MP7. Look for and make use of structure</p> <p>MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLs for ELA Companion Standards</p> <p>RST.9-10.3</p> <p>RST.9-10.4</p> <p>RST.9-10.7</p> <p>RST.11-12.3</p> <p>RST.11-12.4</p> <p>NJSLs-CLKS</p> <p>- 21st Century Life and Careers</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Benchmark assessments (B) - take home investigations (F) - graphing calculator assignments (F) - Sketchpad assignments and Calculus-in-motion labs (F) - alternative assessments (A) - partial derivative problem sets (F) 	<p>Selection of primary sources</p> <p><i>Suggestion(s):</i></p> <p>Texts: Larson text; Stewart text; Deltamath (remediation, on grade level, and advanced)</p> <p>Graphic organizers available in teacher shared folders</p> <p>Modifications and Accommodations:</p> <p>Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students' IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning.</p> <p>Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students' understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed.</p> <p>Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling.</p> <p>Gifted and Talented Students: Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>

	<p>be incorporated to support conceptual understanding</p> <p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - Applications from science and engineering will be included, when appropriate 	<p>9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		
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<p>Unit 5 – Multiple Integrals</p> <p>Time: 9 weeks</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - MI-1 Double Integrals Over Rectangles (Stewart 15.1) (1/2 week) - MI-2 Iterated Integrals (Stewart 15.2) (1/2 week) - MI-3 Double Integrals Over General Regions (Stewart 15.3) (1 week) - MI-4 Double Integrals in Polar Coordinates (Stewart 15.4) (1 week) - MI-5 Applications of Double Integrals (Stewart 15.5); Applications - Density and Mass, Moments and Centers of Mass, Probability (1 week) - MI-6 Surface Area (Stewart 15.6) (1 week) - MI-7 Triple Integrals (Stewart 15.7); Physics Applications - Moments of Inertia and Electric Charge (1 week) - MI-8 Triple Integrals in Cylindrical Coordinates (Stewart 15.8) (1 week) - MI-9 Triple Integrals in Spherical Coordinates (Stewart 15.9) (1 week) - MI-10 Change of Variables in Multiple Integrals (Stewart 15.10) (1 week) 	<p>NJSLs SMP</p> <p>MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLs for ELA Companion Standards</p> <p>RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLs-CLKS - 21st Century Life and</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Benchmark assessments (B) - take home investigations (F) - graphing calculator assignments (F) - Sketchpad assignments and Calculus-in-motion labs (F) - alternative assessments (A) - problem sets involving multiple integrals (F) 	<p>Selection of primary sources <i>Suggestion(s):</i> Texts: Larson text; Stewart text; Deltamath (remediation, on grade level, and advanced)</p> <p>Graphic organizers available in teacher shared folders</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students' IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students' understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed. Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling. Gifted and Talented Students: Students who excel in their mastery of course standards will be</p>

	<p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - Scaffolding strategies will be utilized to support students' ability to evaluate multiple integrals - Multiple representations will be incorporated to support conceptual understanding <p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - This unit will incorporate Physics applications related to density, mass, and inertia 	<p>Careers 9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		<p>further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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Advanced Topics in Calculus – This full-year course will extend key ideas of one-variable calculus to functions with several variables. Topics will include the three-dimensional coordinate system, vectors, equations of lines, planes, cylinders, and quadric surfaces in three-dimensional space, vector functions and their applications to arc length, curvature, and motion in space, partial derivatives, multiple integrals, and theorems of vector calculus. Applications of these concepts will be a critical component of this course.

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<p>Unit 6 – Vector Calculus</p> <p>Time: 8 weeks</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - VC-1 Vector Fields (Stewart 16.1) (1 week) - VC-2 Line Integrals (Stewart 16.2) (1 week) - VC-3 The Fundamental Theorem for Line Integrals (Stewart 16.3) (1 week) - VC-4 Green’s Theorem (Stewart 16.4) (1 week) - VC-5 Curl and Divergence (Stewart 16.5) (1 week) - VC-6 Parametric Surfaces and Their Areas (Stewart 16.6) (1 week) - VC-7 Surface Integrals (Stewart 16.7) (1 week) - VC-8 Stokes’ Theorem (Stewart 16.8) (1/2 week) - VC-9 The Divergence Theorem (Stewart 16.9) (1/2 week) <p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - Technology will be utilized to support students’ ability to visualize and understand new concepts - Multiple representations will be incorporated to support conceptual understanding 	<p>NJSLs SMP</p> <p>MP1. Make sense of problems and persevere in solving them</p> <p>MP2. Construct viable arguments and critique the reasoning of others</p> <p>MP3. Reason abstractly and quantitatively</p> <p>MP4. Model with mathematics</p> <p>MP5. Attend to precision</p> <p>MP6. Use appropriate tools strategically</p> <p>MP7. Look for and make use of structure</p> <p>MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLs for ELA Companion Standards</p> <p>RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLs-CLKS - 21st Century Life</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Benchmark assessments (B) - take home investigations (F) - graphing calculator assignments (F) - Sketchpad assignments and Calculus-in-motion labs (F) - alternative assessments (A) - problem sets on line integrals (F) 	<p>Selection of primary sources <i>Suggestion(s):</i> Texts: Larson text; Stewart text; Deltamath (remediation, on grade level, and advanced)</p> <p>Graphic organizers available in teacher shared folders</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students’ IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed. Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling. Gifted and Talented Students: Students who excel in their mastery of course standards will be further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>

	<p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - This unit will incorporate applications to science and engineering, as appropriate 	<p>and Careers</p> <p>9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		
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Advanced Topics in Calculus – This full-year course will extend key ideas of one-variable calculus to functions with several variables. Topics will include the three-dimensional coordinate system, vectors, equations of lines, planes, cylinders, and quadric surfaces in three-dimensional space, vector functions and their applications to arc length, curvature, and motion in space, partial derivatives, multiple integrals, and theorems of vector calculus. Applications of these concepts will be a critical component of this course.

Content/Topic:	Key Learning Items/Concepts and Pacing Guide	NJSLs	Formative, Summative, Benchmark, and Alternative Assessments	Core Instructional and Supplemental Materials/ Modifications and Accommodations
<p>Unit 7 – Second Order Differential Equations</p> <p>Time: 4 weeks</p>	<p>Key learning items/concepts:</p> <ul style="list-style-type: none"> - DE-1 Second-Order Linear Equations (Stewart 17.1) (1 week) - DE-2 Nonhomogeneous Linear Equations (Stewart 17.2) (1 week) - DE-3 Applications of Second-Order Differential Equations (Stewart 17.3) (1 week) - DE-4 Series Solutions (Stewart 17.4) (1 week) <p>Content-specific modifications and accommodations</p> <ul style="list-style-type: none"> - Technology will be utilized to support students, as needed - Multiple representations will be incorporated to support conceptual understanding <p>Interdisciplinary/additional connections</p> <ul style="list-style-type: none"> - This unit will incorporate applications to science and engineering, particularly in regard to second-order differential equations 	<p>NJSLs SMP</p> <p>MP1. Make sense of problems and persevere in solving them MP2. Construct viable arguments and critique the reasoning of others MP3. Reason abstractly and quantitatively MP4. Model with mathematics MP5. Attend to precision MP6. Use appropriate tools strategically MP7. Look for and make use of structure MP8. Look for and express regularity in repeated reasoning</p> <p>NJSLs for ELA Companion Standards</p> <p>RST.9-10.3 RST.9-10.4 RST.9-10.7 RST.11-12.3 RST.11-12.4</p> <p>NJSLs-CLKS</p>	<p>Students will be assessed regularly throughout this course, with a focus on both conceptual understanding and procedural fluency. Assessment tools may include the following:</p> <ul style="list-style-type: none"> - quizzes (F) - tests (S) - performance tasks (F/S) - projects (S) - homework (F) - discussions (F) - journals (F) - Benchmark assessments (B) - take home investigations (F) - graphing calculator assignments (F) - Sketchpad assignments and Calculus-in-motion labs (F) - alternative assessments (A) - problem sets on second-order differential equations (F) 	<p>Selection of primary sources <i>Suggestion(s):</i> Texts: Larson text; Stewart text; Deltamath (remediation, on grade level, and advanced)</p> <p>Graphic organizers available in teacher shared folders</p> <p>Modifications and Accommodations: Students with special needs: Teachers and support staff will attend to all modifications and accommodations listed in students’ IEPs and 504s. Teachers will incorporate manipulatives, extra time, alternative assessments, scaffolding, spiraling, technology, and flexible grouping to support student learning. Multilingual students: Teachers and support staff will work to support multilingual students in their first language and in English, providing materials and/or resources to support students’ understanding. Students will be given additional time, as appropriate, and translation tools will be utilized as needed. Students at risk of school failure: Formative and summative data will be used to monitor student success, and students at risk of failure will receive additional supports and services, which may include parent consultation, extra help, and differentiation strategies, including small group instruction, group work, scaffolding, and spiraling. Gifted and Talented Students: Students who excel in their mastery of course standards will be</p>

		<p>- 21st Century Life and Careers 9.4.12.CI.1 9.4.12.CI.3 9.4.12.CT.1 9.4.12.CT.2</p> <p>- Technology 9.4.12.IML.3</p> <p>- Career Education 9.2.12.CAP.2 9.3.ST.5 9.3.ST-ET.5 9.3.ST-SM.2</p> <p>NJSLS – CSDT 8.1.12.DA.1 8.1.12.DA.5 8.1.12.DA.6 8.1.12.AP.1 8.2.12.ETW.2</p>		<p>further challenged with more complex tasks, extensions of concepts and skills, and extended problem solving and critical thinking opportunities.</p>
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Activities and Experiences:

At times, students will

- Be taught through the lecture method, where they will work individually and follow the teacher's direction, guidance and modeling.
- Participate in question-and-answer sessions with the whole class or while working in smaller groups.
- Have experiences where they explain or describe their mathematical problem solving strategies to their classmates. This might be written on the blackboard, on a transparency, or on an individual white-board, and then explained to the entire class. Another option might be to work with a small group of students forming a problem-solving team.
- Take notes related to presentations, group-work, textbook readings, or Internet activities.
- Experience open-book tests based either on their own notes, or their textbook material or using online resources.
- Complete pre-designed outlines guiding their note-taking on new or review material.
- Work independently on paper-and-pencil practice of sample examples or homework assignments.
- Read about mathematics in their assigned textbooks or other teacher- approved resources.
- Communicate mathematically through written, oral, symbolic, and visual forms of expression. These may consist of journal entries, responding to open-ended questions, creating and analyzing graphs, or individual and group projects and presentations.
- Have opportunities to brainstorm, working from the known to the unknown, seeing relationships and patterns, making connections, and generalizing and discovering rules.
- Have opportunities where they will explain and describe their mathematical thinking and problem-solving process(es).
- Regularly and routinely use graphing calculators, computers and other mathematical tools to enhance mathematical thinking, understanding, and power. This may mean using a graphing calculator and software such as *Excel* or *Geometer's Sketchpad*.
- Explore and discover mathematical relationships and patterns using simulations based or hands-on laboratory-type explorations, online Internet resources, or computer-generated simulations (i.e., using *Excel* or *Geometer's Sketchpad*.)
- Use real-life data to problem solve. These exercises may be based on textbook material, student-collected data from local surveys, teacher- created material, online resources, and Internet or e-mail generated projects.
- Be given assignments to work individually, in pairs or in groups to problem solve. These may include cooperative-learning jigsaw groupings where each team specializes in one aspect of a topic and students re-group and teach their new knowledge to other classmates. This may include a teacher-created Webquest where students follow teacher-selected Internet sites to learn about a curriculum-related topic.
- Experience activities based on mathematical games and original projects.
- Be given real-life problems where they can select and apply various methods and tools to reach their conclusions.
- Use a variety of estimation strategies and recognize situations in which estimation is appropriate.
- Create rubrics to determine criteria for projects or open-ended questions.

- Take tests that include both individual paper-and-pencil assessments, and group-assignments. They also may be assessed through alternative methods such as individual Chapter-Review Projects, interviews, open-ended questions, matching or short-answer questions, or individual/team projects.

Textbooks:

- Larson, Hostetler, Edwards. *Calculus with Analytic Geometry*. Houghton Mifflin Company, 7th edition, 2002.
- Stewart. *Multivariable Calculus*. Cengage Learning, 8th edition, 2015.