Glen Ridge Public Schools –Mathematics Curriculum

Course Title: AP Calculus AB

Subject: Mathematics

Grade Level: 12th

Duration: 1 year

Prerequisite: Pre- Calculus Honors grade of "B" or better; Teacher Recommendation

Elective or Required: Elective

Mathematics Mission Statement

Mathematics is an integral part of our lives. Students must be actively involved in their mathematics education through the use of modeling and demonstrating the ability to persevere through problem solving. The mathematics curricula will emphasize critical thinking skills through a balance of logic and reasoning, attention to precision by utilizing patterns and structure, and bridging these ideas to cross-curricular learning. Students will be engaged and challenged in a student-centered learning environment that is developmentally appropriate and will communicate mathematical ideas, both in a verbal and written form. Through effectively applying hands-on manipulatives, basic computation skills and the use of technical writing to justify their processes, students will critique the work of themselves and others.

Course Description:
AP Calculus is recommended for a student with a strong foundation in algebra, geometry, and trigonometry. AP Calculus students should possess a passion to learn mathematical concepts at a higher level and should have exceptional work ethics. The course is designed to give students a solid understanding of the Calculus concepts first, then apply them to a variety of problem solving situations next. The course prepares the students for the AP Calculus Exam that is administered in May. Students may then use their results from the exam to receive college credits or placement in accelerated courses from their college or university.

Author: Cluny Mendez
Date Submitted: Summer 2017

AP Calculus AB

Topic/Unit: Prerequisites for Calculus

Approximate # Of Weeks: 2 weeks

Essential Questions:
How do you write the equation of a line in slope-intercept form, point slope form, and standard?
What is a function and why is it significant?
What are the basic functions and what do their graphs look like?
How do you use the trigonometric functions in problem solving situations?
What are the graphs the 6 basic trig functions?
How do you find an inverse of a function algebraically?
How do you graph a function's inverse graphically?
What is the property that proves two functions are inverses of each other?

NJCCS: A-SSE 3, 4, 5. A-APR 2, 3, 4. A-REI 1, 2, 3, 4, 5, 6, 7, 10, 11, 12. F-IF 1, 2, 3, 4, 5, 6, 7, 8, 9. F- BF 1a, 1c, 3, 4, 5. F-LE 1, 2, 3, 4, 5

Upon completion of this unit students will be able to:
- Write an equation of a line in any form.
- Identify and graph all the different types of functions.
- Solve any trigonometric equation.
- Graph any trigonometric function.
- Use trigonometric functions to problem solve.
- Find the inverse of a function algebraically and graphically.
- Prove two functions are inverses.
- Solve problems involving inverses.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21st –Century Life & Career Skills
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will participate and takes notes on Smartboard Lessons and activities.
- Students will compare graphs with each other and discuss correct graphing techniques of functions.
- Students will work on problem sets independently, discuss findings in small groups, then review and reinforce as a class.

Enrichment Activities:
- Students will be introduced to the AP Exam and see how important their understanding of functions and equations is by highlighting and identifying questions that involve these topics.

Methods of Assessments/Evaluation:
- Pair/ Share
- Revisit Essential Questions
- Unit test
- Journals
- Multi- media Presentations
- Self -assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments
- Track progress on learning goals chart

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- Textbook Chapter 1 omit section 1.4

Prerequisite Learning Goals Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment 2 I need more practice 1 I don't understand
1	• Write equations of lines	
2	• Graph basic functions • Prove functions are inverses	
3	• Solve trig equations • Find inverses	
4	• Problem solve with functions	

AP Calculus AB

Topic/Unit: Limits and Continuity

Approximate # Of Weeks: 3 weeks

Essential Questions:
What is the difference between average rate of change and instantaneous rate of change?
Can you evaluate a limit graphically and algebraically?
How do limits involving infinity work?
What is continuity?
If a function isn't continuous how do you evaluate one and two-sided limits?
How do limits and slopes of tangent lines relate to each other?
Can you apply limit properties to a function to find the equation of a tangent line?

NJCCS: N-Q 1, 2, 3. A-SSE 3a. F-IF 1, 2, 4, 5, 6, 7, 9.

Upon completion of this unit students will be able to:
- Calculate average and instantaneous rates of change.
- Evaluate limits graphically and algebraically.
- Evaluate limits at infinity and infinite limits.
- Identify if a function is continuous or not.
- Evaluate "zero over zero" type of limits.
- Find the slope of a tangent line at a point on a function.
- Write an equation for the line tangent to a function.
- Calculate the equation that will give the slope of a tangent line at any given point.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21 st –Century Life Career Skills
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will take notes and participate in Smartboard Lessons.
- Students will complete piecewise graphing activity.
- Students will complete "Zero over zero" worksheet in groups.
- Students will work on and complete classwork and homework problems
- independently and in small groups.
- Students will discuss solutions to problems in small groups and then as a class.
- Students will watch and draw conclusions from demonstrations using Calculus in Motion.

Enrichment Activities:
- Blog responses to finding certain types of functions.

Methods of Assessments/Evaluation:
- Pair/ Share
- Revisit Essential Questions
- Journal Reflection
- Unit test
- Journals
- Multi- media Presentations
- Discussion Board/Blog
- Self-Assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments
-

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- Textbook Chapter 2

Limits and Continuity Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment 2 I need more practice 1 I don't understand
1	• Evaluate limits graphically • Evaluate limits algebraically • Determine points of discontinuity	
2	• Evaluate 0/0 limits • Evaluate limits involving infinity	
3	• Use limits to find the slope of tangent lines	
4	• Write the equation of a tangent line	

AP Calculus AB

Topic/Unit: Derivatives

Approximate # Of Weeks: 5 weeks

Essential Questions:
What is a derivative?
How do you find the derivative of a function using the definition of the derivative?
How to graph a function's derivative?
How do you use the graph of a function's derivative to find the graph of the original function?
Algebraically, how do you find the original function from the derivative of polynomial functions?
When does f'(x) fail to exist?
How are continuity and differentiability related?
What are the different rules to finding the derivatives or more complex functions?
How are derivatives are applied to position, velocity and acceleration functions?
What are the derivatives of the trigonometric functions?
What happens when you take higher order derivatives of trigonometric functions?

NJCCS: N-Q 1, 2, 3. A-CED 1, 2, 3, 4. A-REI 1, 3, 6, 7, 10, 11, 12. F-IF 1, 2, 4, 5, 6, 7, 8, 9. F-BF 3. F-TF 1, 3.

Upon completion of this unit students will be able to:
- Find the derivatives of functions using the definition.
- Graph and function's derivative and the original function from the derivative.
- Explain where and why a derivative may fail to exist.
- Apply the Intermediate Value Theorem for derivatives to problem solving situations.
- Apply the rules for differentiation to finding derivatives of functions algebraically.
- Use derivatives to problem solve with position, velocity and acceleration functions.
- Find the derivatives of the trigonometric functions.
- Use the ti-89 to find derivatives.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21st Century Life & Career Skills
- Standard 8.1- Computer and Information Literacy
- Standard 8.2- Technology Education
- Standard 6.3 Active Citizenship in the 21st Century
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will take notes and participate in Smartboard Lessons.
- Students will complete an activity with graphing functions and their derivatives.
- Students will complete the matching derivatives and their functions activity.
- Students will work independently and in small groups.
- Students will discuss solutions to problems in small groups and then as a class.
- Students will watch and draw conclusions from demonstrations using Calculus in Motion.
- Students will use their Ti-89 to find derivatives.

Enrichment Activities:
- Advanced calculator activity for finding higher order derivatives.

Methods of Assessments/Evaluation:
- Pair/ Share
- Exit Slips
- Game Involving Movement
- Journal Reflection
- Revisit Essential Questions
- Unit test
- Multi- media Presentations
- Journals
- Discussion Board/Blog
- Self-Assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- Textbook Chapter 3

Derivative Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment

		2 I need more practice 1 I don't understand
1	• Find the derivatives of functions using the definition • Find the derivatives of functions involving the rules	
2	• Graph a function's derivative • Graph an original function from the derivative graph • Explain where and why a derivative may fail to exist	
3	• Find the derivatives of functions involving more than one rule	
4	• Use derivatives to problem solve with position, velocity, and acceleration	

AP Calculus AB

Topic/Unit: More Derivatives

Approximate # Of Weeks: 2 weeks

Essential Questions:
How do you use the Chain Rule to find the derivatives of composite functions?
When do you use implicit differentiation and what are the steps?
How do you find the derivatives of the inverse trig functions?
What are the derivatives of exponential and logarithmic functions?

NJCCS: N-Q 1, 2, 3. A-CED 1, 2, 3, 4. A-REI 10, 11, 12. F-IF 1, 2, 4, 5, 6, 7, 8, 9. F-BF 1c, 3, 4, 5. F- LE 1, 2, 3, 4. F-TF 1, 3.

Upon completion of this unit students will be able to:
- Find the derivatives of composite functions.
- Differentiate implicitly.
- Derive and find the derivatives of the inverse trig functions.
- Find the derivatives of exponential and logarithmic functions.
- Use the derivatives in problem solving situations.
- Find the graphs and derivatives on the Ti- 89 graphing calculator.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21st Century Life & Career Skills
- Standard 8.1- Computer and Information Literacy
- Standard 8.2- Technology Education
- Standard 6.3 Active Citizenship in the 21st Century
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will take notes and participate in Smartboard Lessons.
- Students will complete discovery activity with graphing exponential functions and their derivatives.
- Students will complete the matching derivatives and their functions activity.
- Students will work independently and in small groups.
- Students will discuss solutions to problems in small groups and then as a class.
- Students will watch and draw conclusions from demonstrations using Calculus in Motion.
- Students will use their Ti-89 to find derivatives.

Enrichment Activities:
- Chain Rule Activity

Methods of Assessments/Evaluation:

- Pair/ Share
- Exit Slips
- Game Involving Movement
- Journal Reflection
- Revisit Essential Questions
- Unit test
- Multi- media Presentations
- Journals
- Discussion Board/Blog
- Self-Assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- Textbook Chapter 4
- AP Prep Questions

More Derivatives Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment 2 I need more practice 1 I don't understand
1	- None	
2	- Find derivatives of exponential and logarithmic functions - Use the calculator to find graphs of derivatives	
3	- Use implicit differentiation to find derivatives	
4	- Find the derivatives of the inverse trig functions - Use derivatives to problem solve	

AP Calculus AB

Topic/Unit: Applications of Derivatives

Approximate # Of Weeks: 6 weeks

Essential Questions:
How do you find the extreme values of functions?
What is the difference between a local extreme value and an absolute extreme value?
What is the Mean Value Theorem and what does it allow you to find?
What is the connection between the graphs of f', f'' and f'''?
What are the steps in using derivatives to model and optimize?
What are the steps in using derivatives to solve related rate problems?

NJCCS: N-Q 2, 3. A-CED 1, 2, 3, 4. G-MG 1, 2, 3

Upon completion of this unit students will be able to:
- Find extreme values of functions.
- Apply the Mean Value Theorem.
- Connect the graphs of functions and their derivatives.
- Problem solve with derivatives.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21st Century Life & Career Skills
- Standard 8.1- Computer and Information Literacy
- Standard 8.2- Technology Education
- Standard 6.3 Active Citizenship in the 21st Century
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will take notes and participate in Smartboard Lessons.
- Students will work independently and in small groups.
- Students will discuss solutions to problems in small groups and then as a class.
- Students will watch and draw conclusions from demonstrations using Calculus in Motion.
- Students will use their Ti-89 to problem solve.

Enrichment Activities:
- Related Rates Lab Activity

Methods of Assessments/Evaluation:
- Pair/ Share
- Exit Slips
- Journal Reflection

- Revisit Essential Questions
- Unit test
- Multi- media Presentations
- Journals
- Discussion Board/Blog
- Self-Assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- AP Test Prep Questions
- Textbook Chapter 5

Application of Derivatives Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment 2 I need more practice 1 I don't understand
1	• Find possible critical values with derivatives	
2	• Find extreme values of functions with derivates	
3	• Use the Mean Value Theorem • Connect the graphs of the functions of f, f ', and f ' '	
4	• Use derivatives to problem solve	

AP Calculus AB

Topic/Unit: The Definite Integral

Approximate # Of Weeks: 6 weeks

Essential Questions:
What are the three rectangular approximation methods and what are they used for?
What is the definition of the definite integral?
What does an antiderivative of a function give?
How do you define and apply the Fundamental Theorem of Calculus?
How do you calculate the area under a curve by applying the Trapezoidal Rule?
What is the relationship between the Trapezoidal Rule and LRAM and RRAM?

NJCCS: N-Q 2, 3. A-CED 1, 2, 3, 4. F-IF 4, 5, 7, 8. G-MG 1.

Upon completion of this unit students will be able to:
- Approximate areas under a curve using the 4 different techniques.
- Find the exact area under a curve be evaluating a definite integral.
- Find antiderivatives of functions.
- Define and apply the Fundamental Theorem of Calculus.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21st Century Life & Career Skills
- Standard 8.1 Computer and Information Literacy
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will take notes and participate in Smartboard Lessons.
- Students will complete The Pump and The Airplane problems to introduce areas under a curve.
- Students will work independently and in small groups.
- Students will discuss solutions to problems in small groups and then as a class.
- Students will watch and draw conclusions from demonstrations using Calculus in Motion.
- Students will use their Ti-89 to integrate problems that cannot be done by hand.

Enrichment Activities:
- Simpson's Rule Activity

Methods of Assessments/Evaluation:
- Pair/ Share
- Exit Slips
- Journal Reflection
- Revisit Essential Questions

- Unit test
- Multi- media Presentations
- Journals
- Discussion Board/Blog
- Self-Assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- AP Test Prep Questions
- Textbook Chapter 6

The Definite Integral Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment 2 I need more practice 1 I don't understand
1	• None	
2	• Use the rectangular approximation methods to approximate area under a curve • Use the Trapezoidal Rule to approximate the area under the curve	
3	• Evaluate definite integrals • Use the Fundamental Theorem of Calculus	
4	• Find anti-derivates	

AP Calculus AB

Topic/Unit: Differential Equations and Mathematical Modeling

Approximate # Of Weeks: 6 weeks

Essential Questions:
How do you graph a slope field?
How does an initial condition impact the graph of your slope field?
When do you use anti-differentiation by substitution and how does it work?
How do you solve exponential growth and decay problems by applying antidifferentiation rules?

NJCCS: N-Q 2, 3. A-CED 1, 2, 3, 4. F-IF 4, 5, 7, 8. F-LE 1, 2, 3, 4, 5. G-MG 1.

Upon completion of this unit students will be able to:
- Graph slope fields.
- Overlay solutions on slope fields.
- Aniti-differentiate but substitution.
- Solve real world problems involving growth and decay.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21st Century Life & Career Skills
- Standard 8.1- Computer and Information Literacy
- Standard 8.2- Technology Education
- Standard 6.3 Active Citizenship in the 21st Century
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will take notes and participate in Smartboard Lessons.
- Students will complete introductory activities for slope fields.
- Students will work independently and in small groups.
- Students will discuss solutions to problems in small groups and then as a class.
- Students will watch and draw conclusions from demonstrations using Calculus in Motion.

Enrichment Activities:
- Activity using the Ti- 89 to draw slope fields.

Methods of Assessments/Evaluation:
- Pair/ Share
- Exit Slips
- Game Involving Movement
- Journal Reflection
- Revisit Essential Questions

- Unit test
- Multi- media Presentations
- Journals
- Discussion Board/Blog
- Self-Assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- Textbook Chapter 7, omit 7.3, 7.5

Differential Equation Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment 2 I need more practice 1 I don't understand
1	• Graph a slope field • Use an initial condition and overlay a solution on the slope field	
2	• None	
3	• Anti-differentiate by substitution	
4	• Problem solve growth and decay problems	

AP Calculus AB

Topic/Unit: Applications of Definite Integrals

Approximate # Of Weeks: 6 weeks

Essential Questions:
How do you describe an integral as net change?
How do you calculate the areas in a plane by using integrals?
How do you calculate the volumes of solids formed by areas?
How do you calculate the volumes of solids formed by revolving areas around axes?

NJCCS: N-Q 2, 3. A-CED 1, 2, 3, 4. F-IF 4, 5, 7, 8. F-LE 1, 2, 3, 4, 5. G-GMD 4. G-MG 1.

Upon completion of this unit students will be able to:
- Apply properties of definite integrals to solving rate problems.
- Calculate the areas in planes by using integrals.
- Calculate volumes of cross sectional areas of different shapes.
- Calculate volumes of revolution.

Interdisciplinary Standards (njcccs.org)
- Standard 9.1 21st Century Life & Career Skills
- Standard 8.1- Computer and Information Literacy
- Standard 8.2- Technology Education
- Standard 6.3 Active Citizenship in the 21st Century
- Standard 5.1 Science Practices

Activities – include 21st Century Technologies:
- Students will take notes and participate in Smartboard Lessons.
- Students will complete integral as net change activities.
- Students will explore different shapes that give a cross sectional area.
- Students will revolve areas around axes and calculate their volumes.
- Students will work independently and in small groups.
- Students will discuss solutions to problems in small groups and then as a class.
- Students will watch and draw conclusions from demonstrations using Calculus in Motion.
- Students will use the Ti-89 graphing calculator to problem solve.

Enrichment Activities:
- L'Hopital's Rule Lesson.

Methods of Assessments/Evaluation:
- Pair/ Share
- Exit Slips

- Journal Reflection
- Revisit Essential Questions
- Unit test
- Multi- media Presentations
- Journals
- Discussion Board/Blog
- Self-Assessments
- Think/Pair/Share
- Homework
- Classwork
- Independent work
- Observation
- Weekly Assessments

Resources/Including Online Resources
- Online Textbook Information
- Teacher Webpage
- Khan Academy
- Desmos
- AP Exam Prep Questions
- Textbook Chapter 8 omit 8.4, 8.5

Application of Integrals Self-Assessment Chart

Learning Level	Objectives	Assessment 4 I can teach others 3 I can pass an assessment 2 I need more practice 1 I don't understand
1	• None	
2	• Use the integral to find net change	
3	• Use integrals to build volumes out of areas	
4	• Use integrals to find volumes of revolution	