Course Outline, Mathematics
- Pre-calculus -

Course Description:
Pre-calculus does provide the necessary foundation for students intending to continue on to calculus. The course will emphasize mathematical thinking, the use of mathematical models, and the understanding of mathematical functions and graphs. Specified topics include equalities and inequalities, polynomial functions, rational functions, exponential functions, logarithmic functions, and trigonometric functions.

Course Objectives:
This course is intended to:

- Help students understand and appreciate the major concepts of functions.
- Prepare students for calculus.
- Make students aware of the applications of pre-calculus mathematics in client disciplines.
- Engage students in mathematical reasoning.
- Develop students’ abilities to approach pre-calculus topics from graphical, numerical, and symbolic points of view.
- Help students learn to read mathematics and to become independent learners of mathematics.
- Develop students’ abilities to create mathematical models and use these models to solve problems.
- Engage students in the solution of problems, especially open-ended problems that apply pre-calculus topics.
- Develop students’ ability to write about mathematical ideas and problem solutions.

Essential questions:
1. How are graphs useful in representing data and solving equations?
2. What are the differences in equations versus inequalities?
3. How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?
4. How can collecting, organizing and displaying data help us analyze information and make reasonable predictions and informed decisions?

Instructor: Mr. Goncalves

Classroom: Room 401

Schedule: TBA
Extra help hours: *TBA*

Contact Information:
- **Phone:** Office (212) 772-1220
- **E-Mail:** ggoncalves@erhsnyc.net

Materials:

3. Graphing Calculator: TI-83 is recommended.
4. Pencils, an eraser, a ruler (preferably a protractor), and a compass.
5. Graph Paper.
7. Folder or binder to keep quizzes, exams, and handouts.

Teaching Strategies:

1. Lecture on concepts and techniques.
2. Presentation of examples and strategies.
3. Large and small group discussions and explorations.
4. Reading and writing assignments.
5. Practice and learning through homework assignments.
6. Applications to demonstrate relevance and extend learning.
7. Active student engagement in group work and discussions.
8. Quizzes, and tests to encourage and monitor learning.

Course Requirements:

1. Regular attendance in class.
2. Homework primarily self-assessed, completion expected. Students will be assigned daily homework and encouraged to use the composition book. Homework assignments submitted past due date will not be accepted unless under extreme circumstances. Homework quizzes will be given weekly to ensure learning.
3. Active participation and engagement in full-class, small-group, and individual activities.
4. Quizzes, tests, and final examination. At least one-week notice will be given for tests and quizzes. There will be no make up quizzes or tests unless the instructor is informed in advance and an acceptable written note is provided with a justification for the absence. There will be no test revisions.
5. Notebook: Students strongly encouraged to take notes during class. Extra credit will be awarded to students who capture complete notes in an orderly manner.
6. Pencil and eraser: Ink is not allowed on any assignment or test.
**Homework:** Students are encouraged to complete all homework problems soon after the section is discussed in class. Questions for the quiz every other week will for the most part be based on these problems. The instructor may also collect particular homework assignments in order to provide constructive feedback to the students and to verify that students are making reasonable progress on these assignments. Students are encouraged to discuss homework questions with the instructor and other students. The work submitted should be your own though. A limited amount of time at the beginning of each class will be allocated for discussion of homework problems.

**Quizzes:** Quizzes will be given every week (except on a test day), and will be equivalent to a 30% of your final grade. No make-up quizzes will be allowed.

**Exams:** There will be two to three exams per marking period. The exams are composed of multiple choice and free-response questions. Each exam is worth 40 points and they are cumulative. There are NO test revisions.

**Classroom Policies:**

1. Active participation requires attendance and arrival to class in time to be prepared for work when the class period begins. Students arriving late on the day of a quiz or test will not be given extra time.
2. Respect your classmates as well as your instructor. Discussion in class will pertain to the topic of the course. All students have a right and responsibility to ask questions and give insight related to the understanding of course content. Students having a large number of questions should consult the instructor outside of class.
3. Participation in large and small group discussions is required and assessed for active engagement and contribution.
4. All work turned in on tests, quizzes, and individual papers must be entirely your own. Behavior contrary to this will result in a grade of F on the assignment. On homework, acknowledge any ideas you received from others. Students should be aware of and adhere to the college’s policy on plagiarism.
5. You are encouraged to study together outside of class. The work you turn in should be entirely your own, though. If you receive help in completing the homework, make sure you put away any notes, write the answer in your own words, and give credit to your collaborators.

**Guidelines for group work:**

1. Every group member has the right and responsibility to contribute to the group’s work. All members of the group are to be respected and listened to. If you find that you tend to dominate the group discussion, make an extra effort to enable and encourage other group members to participate. If the work is to be submitted, make sure there is a copy (preferably more than one) in class on the day it is due.
2. Share your ideas with others. You’ll be surprised to find out how often your ideas will help lead to a right answer! No idea or question is stupid.
3. Arrive prepared and ready to start. When discussing homework in a group, be sure to try all problems in advance and identify where you have questions.
4. During an in-class activity, do not ask the instructor for assistance until everyone in the group has the same question.
5. Take responsibility for your own learning. Share your strategies/questions with the aim of having others understand what you are getting at and where/why you are stuck. This is different from “I couldn’t get ...” and expecting another student to show you their answer.
6. Avoid taking responsibility for someone else’s learning (since they will not learn). Listen to others with the aim of understanding their strategies and questions. This is more beneficial (and harder) than just showing them how to do it your way.

7. Even when there are no questions, spend some group time comparing resolutions. It feels great to show something amazing you’ve come up with or to share in someone else’s solution. Take some time to enjoy these moments.

8. Have fun, but stick to task.

**Grading Policy:**

Criteria for computing grades: 

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exams</td>
<td>40%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>30%</td>
</tr>
<tr>
<td>Homework Quizzes/ Group Work</td>
<td>20%</td>
</tr>
<tr>
<td>Class Participation</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Suggestions and Resources:**

1. One-on-one with teacher: Students are encouraged to approach the instructor either immediately after school or via email.
2. Textbook reading assignments: Read each section before class discussion, then re-read as homework activities are assigned, and use this material to study for quizzes and exams. In-class activities leverage textbook examples.
3. Homework assignments: Make an effort to figure out even the more challenging homework problems, try multiple times, even consider a break in between turns. Often the brain works it out while doing other things.

**ERHS Academic Honesty Requirement:**

Academic Dishonesty will not be tolerated.

I have read and am aware of the grading policy for Mr. Gonçalves’ class.

Student name: ________________________________

Student signature: ___________________________ Date: ___/___/___

Parent/Guardian name: _______________________

Parent/Guardian signature: ___________________ Date: ___/___/___
**Tentative Course Outline:**

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.1</td>
<td>3 or 4 days 1 quiz</td>
<td>✓ Representing Real numbers (Natural numbers, whole numbers, integers, rational, irrational) ✓ Order and interval notation</td>
</tr>
<tr>
<td>A.1 Pages 843-848</td>
<td>3 or 4 days 1 quiz</td>
<td>✓ Radicals ✓ Simplifying radical expressions ✓ <em>Solving radical equations</em> ✓ Rationalizing the denominator ✓ Integer and Rational exponents</td>
</tr>
<tr>
<td>P.6 Pages 53-60</td>
<td>3 or 4 days 1 quiz</td>
<td>✓ Definition of Absolute-value (algebraically pg. 14 and geometrically pg. 15) ✓ <em>Solving Absolute-value equations</em> ✓ Absolute-value inequalities</td>
</tr>
<tr>
<td>P.4</td>
<td>5 or 6 days 1 quiz</td>
<td>✓ Slope of a line ✓ Point-slope form equation ✓ Slope-intercept form ✓ Graphing linear equations ✓ Parallel and Perpendicular lines ✓ Linear equations in two variables (solving them graphically and algebraically) ✓ Linear modeling and correlation coefficient</td>
</tr>
<tr>
<td>P.5</td>
<td>6 – 8 days 1 quiz</td>
<td>✓ Solving equations graphically ✓ Graphing quadratic equations ✓ <em>Solving quadratic equations</em> – factoring, square roots, completing the square, and quadratic formula ✓ Optimization ✓ Motion problems – Ex: Calculate the maximum height of a rocket ✓ Discriminant ✓ Solving system of non-linear equations algebraically (line and parabola, line and circle) ✓ Using completing the square to write an equation for a circle</td>
</tr>
<tr>
<td>2.5 Pages 221-228</td>
<td>10 – 12 days 1 quiz</td>
<td>✓ Imaginary numbers ✓ Complex numbers ✓ Addition and subtraction of complex numbers ✓ Multiplication and division of complex numbers ✓ Solving quadratic equation with imaginary roots</td>
</tr>
<tr>
<td>Section</td>
<td>Pages</td>
<td>Time</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>------</td>
</tr>
</tbody>
</table>
| A.2     | 848-855 | 6-10 days | 1-2 quizzes | ✔ The nature of the roots of any quadratic equation  
✔ Using given conditions to write a quadratic equation  
✔ Solution of system of equations  
✔ Quadratic inequalities  
✔ Adding, subtracting, and multiplying polynomials  
✔ Special products  
✔ Factoring polynomials using special products  
✔ Factoring trinomials  
  (1) Factoring by grouping  
  (2) Factoring the sum and difference of two cubes |
| A.3     | 856-860 | 8-10 days | 2 quizzes | ✔ Domain of an algebraic Expression  
✔ Domain of rational expression (1st commandment of math)  
✔ Reducing Rational expressions  
✔ Multiplying and dividing rational expressions  
✔ Adding or subtracting rational expressions  
✔ Simplifying complex fractions |
| 2.8     | 249-257 | 4 days | 1 quiz | ✔ Solving Rational equations  
✔ Extraneous Solutions  
✔ Applications |
| 1.2     | 81-100 | 6-10 days | 2 quizzes | ✔ Function definition and notation  
✔ Domain and Range  
✔ Continuity  
✔ Increasing and Decreasing Functions  
✔ Local and Absolute Extrema (Extreme Value Theorem – EVT)  
✔ Symmetry (even and odd functions)  
✔ Asymptotes (horizontal and vertical)  
✔ End Behavior |
| 1.3     | 101-112 | 2-4 days | 1 quiz | ✔ Twelve basic functions  
✔ Analyzing functions graphically  
✔ Piecewise functions |
| 1.4     | 113-130 | 4-6 days | 1 quiz | ✔ Composition of Functions  
✔ Relations and Implicity Defined functions  
✔ Relations defined Parametrically (Section 6.3 pg. 522)  
✔ Inverse functions |
| 1.5     | 131-142 | 2 days | 1 quiz | ✔ Graphical transformations  
✔ Vertical and Horizontal translations  
✔ Reflections  
✔ Vertical and Horizontal stretches and shrinks  
✔ Composition of transformations |
| 1.6     | 142-155 | 2-4 days | 1 quiz | ✔ Functions from formulas  
✔ Functions from graphs  
✔ Functions from data – page 149 (Regression Types) |
| 2.1     | 162-180 | 6 days | 1 quiz | ✔ Polynomial functions  
✔ Linear functions and their graphs  
✔ Average rate of change  
✔ Linear correlation and modeling  
✔ Quadratic functions and their graphs |
| 2.2     | 181-192 | 4 days | 1 quiz | ✔ Power functions and variation (direct and inverse)  
✔ Graphs of power functions (x^3, x^1/2, x^-1/2)  
✔ Modeling with power functions |
<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
<th>Days</th>
<th>Quizzes</th>
<th>Topics</th>
</tr>
</thead>
</table>
| 2.3 | 193-206 | 6 | 1 | ✓ Graphs of Polynomials functions  
✓ End behavior of polynomial functions  
✓ Zeros of polynomials functions  
✓ Intermediate Value Theorem  
✓ Modeling |
| 2.4 | 207-220 | 8 | 1 | ✓ Long division  
✓ Remainder and Factor Theorems  
✓ Synthetic Division  
✓ Rational Zeros Theorem  
✓ Upper and Lower bounds |
| 2.6 | 229-236 | 4 | 1 | ✓ Fundamental Theorem of Algebra  
✓ Linear Factorization Theorem  
✓ Complex Conjugate Zeros |
| 2.7 | 237-248 | 6 | 1 | ✓ Rational functions \( y = 1/x \)  
✓ Limits and Asymptotes  
✓ Analyzing Graphs of Rational Functions |
| 2.9 | 258-268 | 3 | 1 | ✓ Polynomial inequalities  
✓ Rational inequalities  
✓ Applications |
| 3.1 | 276-289 | 3 | 1 | ✓ Exponential functions and their graphs  
✓ The Natural Base \( e \)  
✓ Transformations |
| 3.2 | 190-299 | 4 | 1 | ✓ Constant percentage rate  
✓ Exponential growth and decay  
✓ Modeling |
| 3.3 & 3.4 | 300-319 | 10 | 1 | ✓ Inverses of exponential functions  
✓ Logarithmic functions and their graphs  
✓ Common log and natural log  
✓ Properties of logarithmic functions  
✓ Change of base |
| 3.5 & 3.6 | 320-341 | 10 | 2 | ✓ Solving exponential equations  
✓ Solving logarithmic equations  
✓ Regression models (page 328)  
✓ Mathematics of finance  
✓ Interest Compounded Annually  
✓ Interest Compounded \( k \) times per year  
✓ Interest Compounded Continuously |
| 4.1-4.3 | 352-385 | 18-22 | 2-3 | ✓ The right triangle (sine, cosine, tangent, and their reciprocals)  
✓ Angles as rotations  
✓ Sine and cosine as coordinates  
✓ The sine and cosine functions: Sinusoidal Functions  
✓ The tangent function  
✓ Function values of special angles  
✓ Finding reference angles  
✓ Radian measure (at this point students should start thinking in radian)  
✓ Trigonometric functions involving radian measure  
✓ The Pythagorean identities  
✓ Cofunctions |
| 4.4-4.8 | 386-438 | 8 – 12 | 1-2 | ✓ The wrapping function  
✓ Graph of \( y = \sin x \) and \( y = \cos x \)  
✓ Amplitude, Frequency, and Period |
<table>
<thead>
<tr>
<th>Area</th>
<th>Time</th>
<th>Quizzes</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sketching sine and cosine curves</td>
<td></td>
<td></td>
<td>✓ Sketching sine and cosine curves</td>
</tr>
<tr>
<td>Transformations of sine and cosine curves – 3 days</td>
<td></td>
<td></td>
<td>✓ Transformations of sine and cosine curves – 3 days</td>
</tr>
<tr>
<td>Graph of y = tan x</td>
<td></td>
<td></td>
<td>✓ Graph of y = tan x</td>
</tr>
<tr>
<td>Graphs of inverse trig functions – arcsine, arccosine, and arctangent</td>
<td></td>
<td></td>
<td>✓ Graphs of inverse trig functions – arcsine, arccosine, and arctangent</td>
</tr>
<tr>
<td>Solving Problems with trigonometry</td>
<td></td>
<td></td>
<td>✓ Solving Problems with trigonometry</td>
</tr>
<tr>
<td>Analytic Trigonometry</td>
<td>20 days</td>
<td>3</td>
<td>✓ Fundamental Identities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ <em>Solving Trigonometric equations</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Proving Trigonometric Identities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Sum and Difference Identities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Multiple Angle Identities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ The Law of Sines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ The Law of Cosines</td>
</tr>
<tr>
<td>Discrete Mathematics (optional)</td>
<td>12 days</td>
<td>2</td>
<td>✓ Basic Combinatorics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ The Binomial Theorem</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Probability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ <strong>Sequences and Series</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Mathematical Induction - <em>optional</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Statistics and Data (Graphical and Algebraic)</td>
</tr>
<tr>
<td>An Introduction to Calculus (optional)</td>
<td></td>
<td></td>
<td>✓ Limits and Motion: The tangent Problem</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Limits and Motion: The Area Problem</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ More on Limits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Numerical Derivatives and Integrals</td>
</tr>
<tr>
<td>System and Matrices</td>
<td>7</td>
<td></td>
<td>✓ Solving System of two equations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Matrix Algebra</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Multivariate Linear Systems and Row Operations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Partial Fractions - <em>optional</em></td>
</tr>
</tbody>
</table>