MANCHESTER REGIONAL HIGH SCHOOL

Precalculus Honors

Revised and adopted
August 2015
Manchester Regional High School Board of Education
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COURSE DESCRIPTION: HONORS PRECALCULUS

Pre-Calculus is designed to cover topics that students need to be successful in calculus as well as college- level algebra. Some of the topics include mathematical functions, including particularly exponential and logarithmic functions and trigonometric functions. Also covered are conics, sequences and series, complex numbers, probability, and matrix operations. Emphasis is on developing under-standing of the underlying concepts and then applying that understanding to solve authentic problems.

COURSE DATA:

Length of course: Full year

Credits: 5- weighted

Periods per week: 5

Classification: Elective - Grades 11, 12

Prerequ isite: Algebra II

EVALUATION:

The purposes of evaluation are to provide information about student progress
and to determine if students have learned the subject matter. Teachers will evaluate student progress by using standardized tests, teacher-made tests, oral question ing, class participation, homework, special projects, and other school records.

EVALUATIVE ACTIVITIES:

Evaluation will be based on the following weighted components: Formal tests: 50%
Quizzes: Homework:
Class participation: Special projects:

20%
10%
10%
10%

Grading structure: Benchmark for mastery of course content is 65%; content mastery for students with IEPs may be less than the Board of Education approved minimum for regular education students.

MANCHESTER REGIONAL HIGH SCHOOL COURSE TITLE: HONORS PRECALCULUS

COURSE PROFICIENCIES:

After completing the course in Honors Precalculus, the student will be able to:

1. Use and apply the distance and midpoint formulas.
2. Draw the graph of a linear or quadratic equation.
3. Describe the symmetry of the graph of an equation.
4. Write the point-slope form of the equation of a l ine.
5. State the definition of a function.
6. Find the domain and range of a function.
7. Graphically represent a function.
8. Represent simple function transformations graphically.
9. Find the composition of two functions.
10. Find the inverse of a one-to-one function.
11. Identify and apply direct, joint and inverse variation.
12. Graph quadratic functions.
13. Graph polynomial functions.
14. Divide polynomials using long division and synthetic division.
15. Find the real zeros of polynom ial functions using Descartes' Rule of Signs.
16. Perform arithmetic operations on complex numbers.
17. Find complex solutions to quadratic equations. 18. Use the Fundamental Theorem of Algebra.
19. Sketch the graph of a rational function.
20. Write the partial fraction decomposition of a rational expression.
21. Draw the graph of exponential and logarithmic functions.
22. Use the natural base e.
23. Identify and use exponential and logarithmic functions.

24. Use the properties oflogarithms to simpl ify calculations.
25. Solve exponential and logarithmic equations.
26. Define the trigonometric functions in terms of the unit circle.
27. Define the trigonometric functions in terms of the ratios in a right triangle.
28. Draw the graphs of the trigonometric and inverse trigonometric functions.
29. Apply the fundamental trigonometric identities.
30. Solve trigonometric equations.
3 1 . Apply the Law of Cosines and the Law of Sines.
32. Understand and use vectors to solve physical problems.
33. Write a complex number in trigonometric form.
34. Understand and apply DeMoivre's Theorem.
35. Solve systems of equations in two variables.
36. Use Gaussian elimination to solve l inear systems in more than two variables.
37. Solve systems of linear inequalities.
38. Solve linear programming problems.
39. Define and use matrices.
40. Perfonn elementary row operations on matrices. 41 . Find the inverse of a square matrix.
42. Find the determinant of a matrix.
43. Find the **nth** term of arithmetic and geometric sequences.
44. Find the sum of arithmetic and geometric series.
45. Use the principle of mathematical induction to prove statements about integers.
46. Use the binomial theorem to expand powers of binomials.
47. Use combinations and permutations.
48. Understand the basics of mathematical probability.
49. Write the equations of conchs in standard and polar form.
50. Find parametric equations for a graph.

HONORS PRECALCULUS STUDENT OUTCOMES

The student will be able to:

Summer Work: UNIT 0.

A study guide will be provided.

Students will have 2 weeks to seek extra help. A test will be issued in class.

UNIT 0: Review of Basic Algebra 1. Use the basic rules of algebra.

2. Simplify exponential expressions.

3. Simplify radical expressions.
4. Expand and factor using special products.
5. Perform algebraic operations on polynomial expressions.
6. Solve algebraic equations.
7. Solve algebraic inequal ities.
8. Avoid common algebraic errors.

Standards and CPI's: 4.4.13, 4.5.8, 4.6.20, 4.6.22, 4.8.13, 4.13.16
CCWR: 3.1, 3.2, 3.8, 3.9, 3.13, 4.2, 4.9

UNIT I: Functions and Graphs--- 4 weeks

1. Plot points in the coordinate plane.
2. Use the distance and midpoint formulas.
3. Sketch the graph of a linear equation.
4. Find the x- and y-intercepts of a graph.
5. Find the slope of a line.
6. Write the point-slope form of a linear equation.
7. Write the equations of paral lel and perpendicular lines.
8. Define a mathematical function.
9. Find the domain and range of a function.
10. Use the vertical line test for a function.
11. Graph the transformations of functions.
12. Define the composition of two functions.
13. Find the inverse of a function.
14. Write a model for direct, inverse, and joint variation.

Standards and CPI's: 4.1-15, 4.1-16, 4.2-10, 4.3-12, 4.5-8, 4.6-22, 4.8-13, 4.10-12, 4.11-14, 4.11-17, 4.11-18, 4.11-19, 4.13-14, 4.13-15, 4.13-17, 4.13-18, 4.13-19, 4.15-17, 4.16-9
CCWR: 3-1, 3-2, 3-8, 3-9, 3-13, 4-2, 4-9

UNIT II: Polynomial and Rational Functions--- 4 weeks

1. Sketch the graph of a quadratic function.
2. Find the equation of a parabola.
3. Approximate the zeros of a polynomial function.
4. Use polynomial long division and synthetic division.
5. Use Descartes' Rule of Signs to find the real zeros of a polynomial function
6. Perform arithmetic operations on complex numbers.

7. Find the complex zeros of a polynomial function.
8. Sketch the graph of a rational function.
9. Write the partial fraction decomposition of a rational expression

Standards and CPI' s:
4.1-15, 4.1-16, 4.2-10, 4.4-13, 4.5-8, 4.6-20, 4.8-13, 4.10-15, 4.10-16, 4.13-17, 4.15-16, 4.15-18, 4.16-2
CCWR: 3-1, 3-2, 3-8, 3-9, 3-13, 4-2, 4-9

UNIT III: Exponential and Logarithmic Functions--- 4 weeks 1 .Sketch the graph of an exponential function.
2. Sketch the graph of a logarithmic function.
3. Find the domain of a logarithmic function.
4. Change base in a logarithmic calculation.
5. Solve exponential and logarithmic equations.

Standards and CPI's:
4.4-12, 4.8-14, 4.11-15, 4.11-17, 4.15-15, 4.15-16
CCWR: 2-7, 3-1, 3-2, 3-7, 3-8, 3-9, 3-13, 4-9, 4-10

UNIT IV: Trigonometry--- 4 weeks
1. Determine the radian measure of an angle.
2. Convert from radian measure to degree measure.
3. Evaluate trigonometric functions of real numbers.
4. Evaluate trigonometric functions as ratios in right triangles.
5. Apply trigonometric identities.
6. Graph the trigonometric functions and their inverses
7. Graph transformations of the trigonometric functions
8. Solve right triangles.
9. Apply trigonometric identities.
10. Solve trigonometric equations.
11. Use the Law of Sines and the Law of Cosines.
12. Write the component form of a vector.
13. Write a vector as a linear combination of unit vector
14. Write the trigonometric form of a complex number.
15. Use DeMoivre's Theorem to find powers of a complex

Standards and CPI' s:
4.1-8, 4.2-10, 4.5-8, 4.7-23, 4.9-17, 4.11-15, 4.15-15, 4.15-16

CCWR: 1-12, 2-1, 2-2, 2-9, 3-1, 3-2, 3-3, 3-7, 3-8, 3-9, 4-2, 4-3, 4-9

Unit V: Systems of Equations and Inequalities--- 4 weeks

1. Use the method of substitution to solve a linear system.
2. Use Gaussian elimination to solve a linear system.
3. Graph a system of linear inequalities.
4. Find the equation of a parabola that passes through given
5. Obtain the optimal solution of a linear programm ing problem.

Standards and CPI's: 4.1-16, 4.6-20, 4.8-13, 4.11-15, 4.11-17, 4.12-22, 4.13-1 6, 4.13-1 7, 4.16-2
CCWR: 1-12, 2-7, 3-1, 3-2, 3-7, 3-8, 3-9, 3-12, 3-13, 4-1, 4-2, 4-9, 4-10

UNIT VI: Matrices--- 4 weeks

1. Identify parts of a matrix.
2. Perform elementary row operations on a matrix.
3. Obtain reduced row-echelon form of a matrix.
4. Perform Gauss-Jordan elimination to solve a system of linear equations.
5. Perform matrix addition and scalar multipl ication.
6. Perform matrix multiplication.
7. Find the inverse of a square matrix.
8. Find the determinant of a square matrix.
9. Identify properties of determinants.

Standards and CPI's: 4.8-14, 4.13-16, 4.13-17
CCWR: 3-8, 3-9, 3-12

UNIT VII: Sequences, Series, and Probability--- 4 weeks

1. Find the nth term of an arithmetic and geometric sequence.
2. Find the sum of the first n terms of an arithmetic and geometric
3. Use mathematical induction to prove statements about positive integers.
4. Obtain binomial coefficients using the binomial theorem.
5. Use the fundamental counting principle.

6. Find the number of combinations of n item.
7. Find the number of permutations of n items.
8. Find the probability of an event.

Standards and CPI's: 4.1-8, 4.2-9, 4.4-12, 4.6-23, 4.2-17, 4.12-23, 4.14-11, 4.14-12, 4.15-12, 4.15-13, 4.15-14, 4.16-2
CCWR: 1-12, 2-7, 3-3, 3-6, 3-7, 3-9, 3-12, 3-13, 3-14, 4-9, 4-10

UNIT VIII: Lines, Conics, and Polar Coordinates--- 4 weeks

1. Find the inclination of a line.
2. Compute the angle between two lines.
3. Find the distance between a point and a line.
4. Graph Parabolas.
5. Find equations of parabolas.
6. Graph Ellipses.
7. Find equations of ellipses.
8. Graph Hyperbolas.
9. Find equations of hyperbolas.
10. Solve applications of conchs.
11. Perform Polar/Rectangular Coordinate conversions.
12. Perform Polar/Rectangular Equation conversions.
13. Generate polar graphs.

Standards and CPI's: 4.1-15, 4.6-22, 4.11-17, 4.13-17, 4.15-15
CCWR: 1-12, 2-1, 2-9, 3-7, 3-8, 3-9, 3-11, 3-12, 3-13, 4-2, 4-10

COURSE OUTLINE: HONORS PRECALCULUS

UNIT I: Functions and Graphs

A. The Cartesian plane
   1. Plotting points
   2. Shifting points
   3. Distance and midpoint formulas
   4. Applications

B. Graphs of equations
   1. Sketching a graph
   2. Intercepts of a graph
   3. Graph symmetry
   4. Equation of a circle

C. Lines in the plane
   1. Slope of a line
   2. Point-slope of an equation of a line
   3. Sketching graphs of lines
   4. Parallel and perpendicular lines

D. Functions
   1. Function notation
   2. Finding the domain and range of a function
   3. Applications

E. Graphs of functions
   1. Increasing and decreasing functions
   2. Even and odd functions
   3. Shifting, reflecting and stretch ing graphs
   4. Step functions

F. Combinations of functions
   1. Arithmetic combinations of functions
   2. Composition of functions
   3. Applications

G. Inverse functions
   1. Existence of an inverse
   2. Finding the inverse

H. Variation and mathematical models 1. Direct variation
   2. Direct variation as nth power
   3. Inverse variation
   4. Joint variation

UNIT IT:

A. Quadratic functions
   1. Graph of a quadratic function
   2. Standard form of a quadratic function
   3. Applications

B. Polynomial functions of higher degree 1. Graphs of polynomials
   2. Leading coefficient test
   3. Zeros of polynomial functions
   4. Intermediate value theorem

C. Polynomial division and synthetic division
   1. Long division of polynomials
   2. Synthetic division
   3. Remainder and factor theorems

D. Real zeros of polynomial functions
   1. Descartes' Rule of Signs
   2. Rational zero test
   3. Bounds for real zeros

E. Complex numbers
   1. Imaginary unit i
   2. Operations with complex numbers
   3. Complex conjugates
   4. Complex solutions of quadratic equations

F. Fundamental theorem of algebra 1. Conjugate pairs
   2. Factoring a polynomial

G. Rational functions
   1. Horizontal and vertical asymptotes
   2. Sketching the graph of a rational function
   3. Slant asymptotes
   4. Applications

H. Partial fractions
   1. Partial fraction decomposition

UNIT III: Exponential and Logarithmic Functions

A. Exponential functions
   1. Graphs of exponential functions
   2. Natural base e
   3. Compound interest
   4. Applications

B. Logarithmic functions
   1. Common logarithmic function
   2. Graphs of logarithmic functions
   3. Natural logarithmic function
   4. Applications

C. Properties of logarithms
   1. Change of base
   2. Rewriting logarithmic expressions

D. Solving exponential and logarithmic equations
   1. Solving exponential equations
   2. Solving logarithmic equations
   3. Applications

E. Exponential and logarithmic applications
   1. Compound interest
   2. Growth and decay
   3. Logistics growth models
   4. Logarithmic models

UNIT IV: Trigonometry

A. Radian and degree measure
   1. Angles
   2. Radian measure
   3. Degree measure
   4. Degrees, minutes, seconds
   5. Applications

B. Trigonometric functions and the unit circle 1. Unit circle
   2. Trigonometric functions
   3. Domain of the sine and cosine

C. Trigonometric functions and right triangles
   1. Trigonometric functions of an acute angle
   2. Trigonometric identities
   3. Applications involving right triangles

D. Trigonometric functions of any angle
   1. Reference angles

E. Graphs of sine and cosine
   1. Basic sine and cosine graphs
   2. Amplitude and period
   3. Translations of sine and cosine

F. Graphs of other trigonometric functions
   1. Tangent function
   2. Cotangent function
   3. Reciprocal functions

G. Inverse trigonometric functions 1 . Inverse sine
   2. Other inverse functions
   3. Compositions of inverse functions with
   4. Applications

H. Applications of trigonometry
   1. Applications involving right triangles
   2. Trigonometry and bearings
   3. Harmonic motion

I. Appl ication of fundamental identities
   1. Verifying identities
   2. Appl ications

J. Solving trigonometric equations
   1. Equations of quadratic type
   2. Functions of multiple angles

3. Using inverse functions

K. Sum and difference formu las
   1. Using sum and difference formulas

L. Multiple angle and product-sum formulas
   1. Power reducing formulas
   2. Half-angle formulas
   3. Product-to-sum formulas

M. Law of sines
   1. Ambiguous case
   2. Applications
   3. Area of an oblique triangle

N. Law of Cosines
   1. Hero's formula

1. Vectors in the plane
   2. Component form of a vector
   3. Vector operations
   4. Unit vectors
   5. Direction angles
   6. Applications

P. Trigonometric form of a complex number
   1. Complex plane
   2. Trigonometric form of a complex number
   3. Multiplication and division of complex numbers
   4. DeMoivre's Theorem and nth roots
   5. Powers of complex numbers
   6. Roots of complex numbers

UNIT V: Systems of Equations and Ineq ualities

A. Systems of equations
   1. Substitution
   2. Graphical approach to finding solutions

3. Applications

B. Systems of linear equations in two variables 1. Method of elimination
   2. Graphical interpretation of solutions
   3. Applications

C. Linear systems in more than two variables
   1. Row-echelon form and back substitution
   2. Gaussian elimination
   3. Non-square systems
   4. Applications

D. Systems oflnequalities
   1. Graph of an inequality
   2. Systems of inequalities
   3. Linear programming
   4. Graphical approach to linear programming
   5. Applications

UNIT VI: Matrices and Determinants

A. Matrices and systems of linear equations
   1. Matrices
   2. Elementary row operations
   3. Gaussian elimination with back substitution
   4. Gauss-Jordan elimination

B. Operations with matrices
   1. Equality of matrices
   2. Matrix addition and scalar multiplication
   3. Matrix multiplication
   4. Applications

C. Inverse of a square matrix
   1. Inverse matrices and Gauss-Jordan elimination
   2. Systems of linear equations

D. The determinant of a square matrix

1. Minors and cofactors of a square matrix
2. Determinant of a square matrix
3. Triangular matrices

E. Properties of determinants
1. Elementary row operations
2. Determinants and the inverse of a matrix

F. Applications of determinants and matrices 1. Cramer's rule
2. Area of a triangle
3. Lines in the plane
4. Cryptography

UNIT VII: Sequences, Series, and Probability

A. Sequences and summation notation 1 . Sequences
2. Factorial notation
3. Sum of a sequence
4. Applications

B. Arithmetic sequences
1. Sum of an arithmetic sequence
2. Arithmetic mean
3. Applications

C. Geometric sequences
1. Sum of a geometric sequence
2. Applications

D. Mathematical induction
1. Sums of powers and integers

E. Binomial theorem
1. . Binomial coefficients
2. Pascal's triangle
3. Binomial expansions

F. Counting principles, permutations, combinations

1. Simple counting problems
2. Counting principles
3. Permutations
4. Combinations

G. Probability
1. Sample spaces
2. Probability of an event
3. Mutually exclusive events
4. Independent events
5. Complement of an event

UNIT VIII: Lines, Conics, and Polar Coordinates

A. Lines 1. 2. 3.

Inclination of a line Angle between two lines
Distance between a point and a line

B. Parabolas
   1. Parabolas
   2. Applications

C. Ellipses
   1. Applications
   2. Eccentricity

D. Hyperbolas
   1. Asymptotes of a hyperbola
   2. Applications

E. Rotation and general second-degree equations
   1. Rotation
   2. Invariants under rotation

F. Polar coordinates
   1. Coordinate conversion
   2. Equation conversion

G. Graphs of polar equations 1. Symmetry
   2. Zeros and maximum r-values
   3. Special polar graphs

H. Polar equations of conics
   1. Alternative definition of conics
   2. Polar equations of conics
   3. Applications

Bibliography

Text: Precalculus, Third Edition

Larson / Hostetler

D.C. Heath and Company, 1993

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Open-Ended Scoring Rubric

Students will utilize ellipses in solving an application (real-world) problem.

Requirements:

- Submit solution with supporting computations.
- Submit an original application requiring the use of an ellipse in solving the problem.

Points	**Criteria**
4	A 4-point response clearly demonstrates understanding of the task, completes all requirements, and provides an insightful explanation/opinion that links to or extends aspects of the text.
3	A 3-point response demonstrates understanding of the task, completes all requirements, and provides some explanation/opinion using situations or ideas from the text as support.
2	A 2-point response may address all of the requirements, but demonstrates a partial understanding of the task, and uses text incorrectly or with limited success resulting in an inconsistent or flawed explanation.
1	A I -point response demonstrates minimal understanding of the task, does not complete the requirements, and provides only a vague reference to or no use of the text.
0	A 0-point response is irrelevant or off-topic.

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Open-Ended Scoring Rubric

Task: To utilize Linear Programming in the context of industrial manufacturing decision-making.

Requirements:

- Submit the solution to the problem
- Include equations, graph, and conlusion

Points	Criteria
4	A 4-point response clearly demonstrates understanding of the task, completes all requirements, and provides an insightful explanation/opinion that links to or extends aspects of the text.
3	A 3-point response demonstrates understanding of the task, completes all requirements, and provides some explanation/opinion using situations or ideas from the text as support.
2	A 2-point response may address all of the requirements, but demonstrates a partial understanding of the task, and uses text inconectly or with limited success resulting in an inconsistent or flawed explanation.
1	A I -point response demonstrates minimal understanding of the task, does not complete the requirements, and provides only a vague reference to or no use of the text.
0	A 0-point response is inelevant or off-topic.

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Open-Ended Scoring Rubric

Task: To use matrices to track and compute manufacturing data.

- Submit report of project computations and solution.

Requirements: _

Points	**Criteria**

4	A 4-point response clearly demonstrates understanding of the task, completes all requirements, and provides an insightful explanation/opinion that links to or extends aspects of the text.
3	A 3-point response demonstrates understanding of the task, completes all requirements, and provides some explanation/opinion using situations or ideas from the text as support.
2	A 2-point response may address all of the requirements, but demonstrates a partial understanding of the task, and uses text incorrectly or with limited success resulting in an inconsistent or flawed explanation.
1	A 1-point response demonstrates minimal understanding of the task, does not complete the requirements, and provides only a vague reference to or no use of the text.
0	A 0-point response is irrelevant or off-topic.

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Open-Ended Scoring Rubric

Requirements:

Point =,

Passaic County Manchester 'Regional High School District

Open-Ended Scoring Rubric

To study the concept of exponential growth by tracking a mold growth.

Requirements:

- Conduct the mold growth experiment with provided resources
- Keep a daily log of growth rate
- Submit a report on the findings
- Make a brief presentation to the class

Points	Criteria
4	A 4-point response clearly demonstrates understanding of the task, completes all requirements, and provides an insightful explanation/opinion that links to or extends aspects of the text.
3	A 3-point response demonstrates understanding of the task, completes all requirements, and provides some explanation/opinion using situations or ideas from the text as support.
2	A 2-point response may address all of the requirements, but demonstrates a partial understanding of the task, and uses text incorrectly or with limited success resulting in an inconsistent or flawed explanation.
1	A 1-point response demonstrates minimal understanding of the task, does not complete the requirements, and provides only a vague reference to or no use of the text.
0	A 0-point response is irrelevant or off-topic.

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Open-Ended Scoring Rubric

Task: Students will investigate patte1ns in graphs of polynomial functions by construction a complex function which meets provided criteria.

Requirements: - Submit the function

- Submit supporting computations/graphs to verify the adequacy of the designed function.

Points	Criteria
4	A 4-point response clearly demonstrates understanding of the task, completes all requirements, and provides an insightful explanation/opinion that links to or extends aspects of the text.
3	A 3-point response demonstrates understanding of the task, completes all requirements, and provides some explanation/opinion using situations or ideas from the text as support.
2	A 2-point response may address all of the requirements, but demonstrates a partial understanding of the task, and uses text incorrectly or with limited success resulting in an inconsistent or flawed explanation.
1	A I -point response demonstrates minimal understandi ng of the task, does not complete the requirements, and provides only a vague reference to or no use of the text.
0	A 0-point response is irrelevant or off-topic.