

MATHEMATICS DEPARTMENT  
COURSE OF STUDY

**HONORS ALGEBRA II**

2010-2011

**Course Number: 522**

**Prerequisites: Prealgebra, Algebra 1 with Successful Placement Test Results or Honors Algebra 2, and Department Recommendation.**

**Calculators: TI-83, TI-84, or Ti-nspire**

Prerequisites: Prealgebra, Algebra I, Placement Test and/or Department Recommendation

Course Description: This course is designed to provide the student with a thorough treatment of all the major topics of basic algebra. These topics include: the operations and axioms of real numbers; operations with polynomials, exponents, radicals and rationals; the solution and graph of linear quadratic, cubic, and quartic polynomial functions and relations; the solution and graph of exponential, logarithmic, rational and radical functions; the solution and graph of systems of linear and quadratic functions and relations; variation; conics, sequences, series and probability & an introduction to trigonometry.

**Unit 1: Sets of Numbers and Their Properties**

Classes: 5

Project: Create a file box to record significant concept learned.  
Create Venn diagram for the sets of numbers.

Nat.Stan: #1,5,6,7,8,9

**Objective 1:** The student will be able to demonstrate an understanding of the Real numbers.

**Proficiencies:**

- 1) Display an understanding of Venn diagrams and set notation.
- 2) Find the union and intersection of sets in a Venn diagram.
- 3) Know the Venn diagram, which integrates the following sets of numbers:  
natural, whole, integers, rational, irrational, transcendental, real, imaginary and complex.
- 4) Display an understanding of the real number line.

**Objective 2:** The student will be able to demonstrate an understanding of the axioms and properties of reals.

**Proficiencies:**

- 1) Know and use the axioms, properties and the definitions of reals.
- 2) Perform basic operations of reals.
- 3) Know and use the rules for the order of operations.
- 4) Complete proofs using properties, axioms and definitions.

**Objective 3:** The student will be able to demonstrate an understanding of the use of algebraic expressions with the reals.

**Proficiencies:**

- 1) Write algebraic expressions from word statements.
- 2) Substitute and evaluate these expressions using reals.
- 3) Write and use exponential notation.

**Objective 4:** The student will demonstrate an understanding of the set of complex numbers and operations with these values.

**Proficiencies:**

- 1) Define the set of imaginary and complex numbers.
- 2) Recognize a complex number in its monomial and binomial forms.
- 3) Simplify an imaginary and complex number.
- 4) Raise an imaginary and complex number to a power.
- 5) Add, subtract, multiply and divide complex numbers.
- 6) Graph a complex number on the complex plane.
- 7) Find the absolute value of a complex number.

**Unit 2: Exponents and their Properties**

Classes: 8

Project: Maintain file box of concepts learned.

Tech: Graphing calculator skills: math menu for exponents and use of the following keys: carat,  $e^x$ , e, etc.

Nat.Stan: #1,3,5,6,7,8,9

**Objective 1:** The student will be able to define and express the concept of an exponent.

**Proficiencies:**

- 1) Define the base, the exponent and the operation of exponentiation.
- 2) Display an understanding of the use of parenthesis with exponents.
- 3) Display an understanding of integer and rational exponents.
- 4) Define and find prime expressions from composite.

**Objective 2:** The student will be able to operate with exponents.

**Proficiencies:**

- 1) Evaluate using exponentiation.
- 2) Know and use the properties of exponents for products, quotients, and powers of powers.
- 3) Use exponents which are negative, zero, fractional, and decimal in form.

- 4) Know, use and operate in scientific notation.
- 5) Know and use significant digits.
- 6) Define the base of e.

### **Unit 3: Polynomial and Operations on Polynomials**

Classes: 25  
 Project: Maintain file box of concepts learned.  
 Tech: Video: [Polynomials](#)  
 Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to display an understanding of the structure of polynomials.

#### **Proficiencies:**

- 1) Know and use the definition of a polynomial.
- 2) Write polynomials in ascending and descending order.
- 3) Give the name and degree of the polynomial.

**Objective 2:** The student will be able to operate with polynomials.

#### **Proficiencies:**

- 1) Add and subtract polynomial, i.e., combine like terms.
- 2) Find products of polynomials.  
     mono • mono; mono • bin; bin • bin; bin • tri; tri • tri
- 3) Square a binomial and trinomial and cube a binomial.
- 4) Perform short and long division with polynomials.
- 5) Perform synthetic division/substitution.
- 6) Factor polynomials over the set of complex numbers.  
     GCF, difference of squares, trinomial squares, quadratic trinomials, difference and sum of cubes, factor by grouping, negative one technique
- 7) Know and use the Rational Root Theorem to factor higher degree polynomials.
- 8) Know and use Descartes' Rule of Signs to determine roots to write the factors of higher degree polynomials.
- 9) Know and use the sum and product of roots formulas for quadratic expressions.
- 10) Write the polynomial from its integer, rational, real and complex roots.

### **Unit 4: Radicals and their Operations**

Classes: 15  
 Project: Maintain file box on concepts learned.  
 Nat.Stan: #1,3,5,6,7,8,9

**Objective 1:** The student will be able to display an understanding of the concept of radicals.

**Proficiencies:**

- 1) Define radical, radicand, index and root.
- 2) Convert radical notation too exponential and vice versa.
- 3) Find the domain of the radical.
- 4) Relate radicals to the closure property.

**Objective 2:** The student will be able to perform operations with radicals.

**Proficiencies:**

- 1) Evaluate a radical.
- 2) Simplify a radical.
- 3) Add and subtract radicals.
- 4) Multiply radicals in monomial, binomial, and trinomial form.
- 5) Divide radicals with monomial and binomial denominators. (Rationalize the denominator.)
- 6) Simplify radicals, which contain algebraic expressions.
- 7) Perform all of these proficiencies on radicals of higher order.

**Unit 5: Rational Algebraic Expressions and their Operations**

Classes: 8

Project: Maintain file box on concepts learned.

Nat.Stan: #1,3,5,6,7,8,9

**Objective 1:** The student will be able to display an understanding of the concept of rational expressions.

**Proficiencies:**

- 1) Define numerator, denominator and vinculum.
- 2) Find the domain of a rational algebraic expression.
- 3) Find the GCF and LCM for rational algebraic expressions and display an understanding of their use with these expressions.

**Objective 2:** The student will be able to perform operations with rational algebraic expressions.

**Proficiencies:**

- 1) Simplify rational algebraic expressions including members with negative exponents.
- 2) Add and subtract rational algebraic expressions with like and unlike denominators.
- 3) Multiply and divide rational algebraic expressions.
- 4) Simplify rational algebraic expressions with a combination of operations.
- 5) Simplify complex rational expressions.

**Unit 6: Exponential and Logarithmic Expressions**

Classes: 8

Project: Maintain file box on concepts learned.

Tech: Video: Exponential and Logarithmic Functions ( 2 of the 6 10 min segments )  
part 1: a matter of scale; part 2: calculating with logs  
Graphing calculator: use of the following keys: log, ln, etc.

Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to demonstrate an understanding of the relationship between exponential and logarithmic expressions.**Proficiencies:**

- 1) Define and use logarithm and antilogarithm.
- 2) Convert exponential to logarithmic expressions and vice versa.
- 3) Evaluate logarithmic expressions, i.e., and finding missing logs or antilogs.
- 4) Determine the domain of a logarithmic expression.
- 5) Write a logarithmic expression as a sum or difference of logs.
- 6) Write a logarithmic expression as a single log.
- 7) Know and use the change of base formula.
- 8) Find decimal approximation for logs.

**Unit 7: Functions and Relations**

Classes: 7

Project: Maintain file box of concepts learned.

Tech: Graphing calculator: entering on the y = menu, setting the viewing window for the graph, determining domain and range, determining intervals of increase or decrease, determining  $f(x)$  is positive or negative, viewing translations and reflections, graphing the line of the average rate of change of a function over a given interval, viewing the vertical and horizontal line tests.

Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to demonstrate and understanding of relations and functions.**Proficiencies:**

- 1) Define a relation and a function.
- 2) Identify a relation and a function from the set of ordered pairs.
- 3) Identify the graph of a relation or function using the vertical line test.
- 4) Determine the domain and the range of a relation or a function from the set of ordered pairs or from the graph.
- 5) Identify and use function notation.
- 6) Determine the dependent and independent variable.

**Objective 2:** The student will be able to demonstrate an understanding of computations with functions and their graphs.

**Proficiencies:**

- 1) Find the value of a function with a given domain.
- 2) Find the domain if the value of the function is given.
- 3) Find the sum, difference, product, quotient and composition of functions and determine the domain.
- 4) Determine the inverse of a function or relation and its domain and range.
- 5) Determine one to one correspondences using the horizontal line test.
- 6) Determine where a function is increasing or decreasing.
- 7) Identify the symmetry of the function as even and odd.
- 8) Identify vertical and horizontal translations of graphs of functions from their equations.
- 9) Identify compressions and stretches of graphs of functions from their equations.
- 10) Identify reflections of the graphs of functions over the axes from their equations.

**Unit 8: Equations and their Solutions**

Classes: 15

Project: Maintain file box of concepts learned.

Tech: Video: Quadratics ( 6 10 min segments )

1) zeros and roots 2) factoring quad and graphs 3) completing the square and roots 4) quad formula and roots 5) complex roots 6) quad in real life.

Graphing calculator: using graph to determine x intercepts as the root of equations, use the trace key, using the calc menu to find zeros, maximums, minimums, etc.

Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to display an understanding of the concept of an algebraic equation.

**Proficiencies:**

- 1) Determine the difference between simplifying and solving.
- 2) Determine the domain of the equation.
- 3) Determine the degree of the equation and its impact on the number of solutions.
- 4) Determine whether the roots or zeros of the equation are x intercepts of the graph of the equation.
- 5) Use the properties of equality to transformation equations.
- 6) Display an understanding of equivalent equations.

**Objective 2:** The student will be able to find the roots of equations.

**Proficiencies:**

- 1) Solve equations with one or two transformations.
- 2) Solve equations with like terms in one or both members.
- 3) Solve equations with distributive property.
- 4) Solve equations with fractions and decimals in the members.
- 5) Solve literal equations and formulas
- 6) Solve absolute value equations.
- 7) Solve equations containing squares or trinomial squares.
- 8) Solve quadratic equations by factoring, completing the square, and the quadratic formula.
- 9) Use the discriminant to determine the nature of the solutions.
- 10) Solve fractional equations and rational algebraic equations including members with higher degree polynomials.
- 11) Solve radical equations with one, two or more radicals in the numerator or denominator.
- 12) Determine extraneous solutions.
- 13) Solve selected higher degree polynomial equations.
- 14) Solve exponential equations.
- 15) Solve logarithmic equations.
- 16) Find inverse equations.

**Unit 9: Inequalities and their Solutions**

Classes: 10

Project: Maintain file box of concepts learned.

Tech: Graphing calculator: viewing the solution to the inequality on viewing screen.

Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to display an understanding of the concept of the algebraic inequality.

**Proficiencies:**

- 1) Know and use the word phrases with indicate an inequality, i.e., is at least; is at most; etc.
- 2) Determine the domain of an inequality.
- 3) Determine the degree of the inequality and its impact on the method of solution.
- 4) Use the properties of inequalities to transform the inequality.
- 5) Display an understanding of equivalent inequalities.
- 6) Know and use the concepts of intersection, union, conjunction, disjunction and their truth tables.

**Objective 2:** The student will be able to solve algebraic inequalities and write their solutions.

**Proficiencies:**

- 1) Write an inequality from a number line graph.

- 2) Graph an inequality on the number line.
- 3) Determine the solutions of an inequality from a replacement set.
- 4) Solve inequalities with multiple transformations: i.e., like terms in one or both members; distributive property; containing fractions and decimals; etc.
- 5) Solve compound inequalities and absolute value inequalities.
- 6) Write these solutions in set notation.
- 7) Graph the solutions of these inequalities.
- 8) Solve quadratic inequality by factoring, quadratic formula and completing the square.
- 9) Solve polynomial and rational inequalities.

### **Unit 10: Analytic Geometry**

Classes: 25

Project: Maintain file box of concepts learned.

Tech: Video: Landscape of Geometry episode on range of change  
 Graphing calculator: graph the following and setting the viewing window ( lines, absolute value, parabolas, cubic, quartic and higher degree, rational, radical, exponential & logarithmic, etc.) , use graph to determine domain, range, asymptotes, and other significant critical features.

**Objective 1:** The student will be able to sketch the graph of relations and functions with their respective critical features.

### **Proficiencies:**

- 1) Sketch the graph of linear equations from all forms of the equation.
- 2) Determine the slope and intercepts.
- 3) Sketch the graph of parallel and perpendicular lines and determine the slope and the equation.
- 4) Sketch the graph of first degree absolute value and determine the slopes and the turning point.
- 5) Sketch the graph of the greatest integer function and determine its discontinuities
- 6) Sketch the graph of quadratic functions & relations determining the vertex, intercepts, axis of symmetry, focus, directrix, minimum or maximum value and points of symmetry.
- 7) Sketch the graphs of rational functions determining the asymptotes, intercepts and points of discontinuity.
- 8) Classify discontinuities as removable or non-removable.
- 9) Sketch the graph of exponential and logarithmic functions, determining the intercept and asymptote.
- 10) Sketch the graphs of higher degree polynomial, determining the intercepts and minimum and maximum values.
- 11) Use the remainder theorem to determine zeros of the polynomial and points on the graph.
- 12) Determine the domain and range for the graphs of all functions and relations.



**Objective 2:** The student will demonstrate an understanding of the graphs of quadratic relations.

**Proficiencies:**

- 1) Know and use the standard and general form of the equation for a circle.
- 2) Determine the center, focus and radius and use these to sketch the graph of the circle.
- 3) Know and use the standard and general form of the equation for an ellipse.
- 4) Determine the center, foci, vertices, and radii and use these to sketch the graph of the ellipse.
- 5) Know and use the standard and general form of the equation for the hyperbola.
- 6) Know and use the equation for the rectangular hyperbola.
- 7) Determine the center, foci, vertices, and asymptotes and use these to sketch of the hyperbola.
- 8) Know and use the standard, general and vertex form of the equation of quadratic relations.

**Objective 3:** The student will be able to recognize the families of functions.

**Proficiencies:**

- 1) Recognize and sketch the parent graph of  $|x|$ ,  $x^2$ ,  $x^3$ ,  $\sqrt{x}$ ,  $a^x$ ,  $\ln x$ .
- 2) Identify and perform horizontal & vertical translations, dilations, and reflections over the x and y axes for these functions.

**Objective 4:** The student will be able to demonstrate an understanding of select formulas from geometry.

**Proficiencies:**

- 1) Know and use the distance formula for horizontal and vertical line segments.
- 2) Know and use the distance formula for oblique line segments.
- 3) Know and use the formula for the distance between a point and a line.
- 4) Know and use the formula for finding the midpoint of a line segment

**Objective 5:** The student will be able to determine the equation of the function from the t chart.

**Proficiencies:**

- 1) Recognize the add-add pattern of the linear function and determine its equation.
- 2) Recognize the add-multiply pattern of the exponential function and determine its equation.
- 3) Recognize the multiply-multiply pattern of the variation function and determine its equation.
- 4) Recognize the second differences pattern of the quadratic function and determine its equation.

**Unit 11: Systems**

Classes: 10

Project: Maintain file box of concepts learned.

Tech: Graphing calculator: to view and find points of intersection

Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to demonstrate an understanding of a system of equations.**Proficiencies:**

- 1) Define a system of equations.
- 2) Determine the minimum and maximum number of possible solutions.
- 3) Determine the dimension of the system.
- 4) Know and use system vocabulary, i.e.; consistent, inconsistent, independent and dependent.

**Objective 2:** The student will be able to solve a system of equations and inequalities.**Proficiencies:**

- 1) Solve 2X2 system of linear equations by graphing, substitution and linear combination.
- 2) Solve 3X3 system of linear equations by linear combination.
- 3) Know and use determinants and Cramer's Rule to solve 2X2 and 3X3 systems of linear equations.
- 4) Solve nonlinear systems of equations by graphing, substitution and elimination.
- 5) Solve systems of linear inequalities by graphing.
- 6) Solve systems of nonlinear inequalities by graphing.

**Unit 12: Problem Solving**

Classes: 25

Project: Maintain file box of concepts learned.

Presentation to class of verbal problem accompanied by some visual aid.

Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to demonstrate an ability to write and solve equations to solve work problems.**Proficiencies:**

- 1) Solve word problems with various themes using one or more variables; i.e., age, digits, consecutive values, dry/wet mixtures, uniform motion (wind, current, etc.), work, related rates, geometry, Pythagorean theorem, ratio, proportion, percent, etc.
- 2) Solve word problems, which generate a linear, quadratic or exponential equation.
- 3) Solve word problems, which generate a direct, inverse, joint or combined variation with integer and non-integer exponents.
- 4) Solve word problems, which generate a system of equations.

**Unit 13: Sequences and Series**

Classes: 5  
 Project: Maintain file box of concepts learned  
 Tech: View the graph of sequences.  
 Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to demonstrate an understanding of a sequence.

**Proficiencies:**

- 1) Write the first several terms of a sequence.
- 2) Write the terms of sequence defined by a recursion formula.
- 3) Find the sum of a sequence using summation notation. ( $\Sigma$ )
- 4) Determine if a sequence is arithmetic or geometric.

**Objective 2:** The student will demonstrate an ability to use the formulas for sequences and series.

**Proficiencies:**

- 1) Know and use the formulas for finding a member of an arithmetic or geometric sequence.
- 2) Know and use the formulas for finding a partial sum of an arithmetic or geometric sequence.
- 3) Know and use the formula for finding the sum of an infinite geometric series.
- 4) Know Pascal's Triangle and the Binomial formula.
- 5) Know and use the Binomial Theorem to find the sum of a binomial raised to a whole number power.
- 6) Find missing members of a binomial expansion.

**ENRICHMENT UNITS:****Unit 14: Combinatorics: Counting and Probability**

Classes: 10  
 Project: Maintain file box of concepts learned.  
 Tech: Video: Probability ( 6 10 min segments )  
 1) uncertain certainty, 2) uniform probability model, 3) simple events  
 4) not so simple events, 5) probability distributions, 6) 6 Bernoulli Trails  
 Nat.Stan: #1,3,4,5,6,7,8,9

**Objective 1:** The student will be able to demonstrate an understanding of the counting principles.

**Proficiencies:**

- 1) Find all the subsets of a set.
- 2) Find the intersection and union of sets.

- 3) Find the complement of a set.
- 4) Know and use the two counting principles.

$$n(A \text{ and then } B) = n(A) \cdot n(B)$$

$$n(A \text{ or } B) = n(A) + n(B) \text{ no elements in common}$$

$$n(A \text{ or } B) = n(A) + n(B) - n(A \cap B) \text{ elements in common}$$

**Objective 2:** The student will be able to demonstrate an understanding of the probability of an event.

**Proficiencies:**

- 1) Define permutations and combinations.
- 2) Know and use factorial notation.
- 3) Solve counting problems by using permutations.

$$P(n, r) = \frac{n!}{(n - r)!}$$

- 4) Solve counting problems by using combinations.

$$C(n, r) = \frac{n!}{(n - r)! r!}$$

- 5) Count permutations with repetitions.
- 6) Use the additive rule to find probabilities of events with intersection and events that are mutually exclusive.
- 7) Compute probabilities of equally likely outcomes.

**Unit 15: Introduction to Trigonometry**

Classes: 3

Project: Maintain file box of concepts learned.

Nat.Stan: #1,2,3,4,5,6,7,8,9

**Objective 1:** The student will be able to recognize, evaluate and graph trigonometric expressions and equations.

**Proficiencies:**

- 1) Recognize a periodic function.
- 2) Find the measurement of angles of rotation.
- 3) Define the six trigonometric functions, period, amplitude and phase shift.
- 4) Find the value of a trigonometric function.
- 5) Graph simple trigonometric functions.
- 6) Write equations of sinusoids from their graphs.
- 7) Know and use the definition of the inverse circular functions.
- 8) Evaluate inverse trigonometric expressions.

**Enrichment Objectives in Trigonometry**

**Objective 2:** The student will be able to know and use the properties of trigonometric functions and to solve simple trigonometric equations.

**Proficiencies:**

- 1) Know the reciprocal, quotient, and pythagorean properties.
- 2) Know and use the odd and even properties.
- 3) Know and use the cofunction properties for circular and trigonometric functions.
- 4) Know and use composite properties.
- 5) Know the multiple and half argument properties.
- 6) Solve simple trigonometric equations over a restricted domain and over the set of Reals.

**Objective 3:** The student will be able to solve triangle problems.

**Proficiencies:**

- 1) Solve right triangles using trigonometric functions.
- 2) Know and use the Law of Cosines to solve oblique triangle problems.
- 3) Use the sine function to find the area of a triangle.
- 4) Use the Law of Sines to solve oblique triangle problems.
- 5) Recognize the ambiguous case in triangles.