

NTHS Curriculum Syllabus

All listed concepts are from the 4-Level track.

Algebra II

Unit 1

Chapter Numbers: 1.1, 2.4, 1.2, 1.3

- Absolute Value Inequalities
- Radicals
- Complex Numbers
- Simplifying Rational Expressions

Unit 2

Chapter Numbers: 3.1, 3.2, 3.3, 3.4, 2.7, 3.5, 3.7

- Odd/Even Functions
- Composite Functions
- Circles (equation)

Unit 3

- Solving high degree polynomial equations
- Solving exponential and radical equations
- Graphing exponential and radical functions
- Solving equations with two absolute values
- Domain, Range, Increasing/Decreasing, zeros

Unit 4

Chapter Numbers: 4.1, 4.2, 4.3

- End behavior (w/o limit notation)
- Descartes' Rule of Signs
- Rational Root Theorem
- Synthetic Division (optional)

- Multiplicity

Unit 5

Chapter Numbers: 4.5

- Graphing rational functions
- Oblique asymptotes
- Removable discontinuities
- Simplifying rational expressions

Trigonometry

Unit 6

Chapter Numbers: 5.1, 5.2, 5.3, 5.4, 5.5

- Domain/Range of Inverse Functions
- Logarithms
- Graphing logarithmic functions
- Simplifying logarithmic expressions
- Change of Base Formula
- Exponential growth/decay
- Half-life

Unit 7

Chapter Numbers: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6,

- Basic trigonometry functions: sin, cos, tan
- Unit Circle
- Basic trigonometry identities
- Graphing trigonometric functions
 - Period, Amplitude, phase-shift

Unit 8

Chapter Numbers: 7.1, 7.2, 7.3, 7.4, 7.6

- Pythagorean Trigonometric Identities
- Cofunction Identities
- Even/Odd Identities
- Sum and Difference Formulae (Trig funcs)
- Double Angle Identities
- Proving Identities

- Solving trigonometric equations
- Inverse trigonometric functions

Analytic Geometry

Unit 1: Conics

- Circles
- Parabolas
 - Foci, Directrix, Latus recta
- Ellipses
 - Foci, vertices, covertices, major axis, minor axis, latus recta
 - Eccentricity
- Hyperbolas
 - Vertices, foci, asymptotes, eccentricity, latus recta
 - Directrix

Unit 2: Transformations

- Terminology
 - Image, pre-image, translated, dilation, invariant, rotation.
- Rotation matrix
- Reflection matrix
- Inverse dilation, inverse rotation, inverse reflection
- Combining transformation matrices.
- Translating axes

Unit 3: Conic Transformations

- Rotating axes
- “Eliminating the xy term”

Unit 4: Polar

- Graphing
- Conversions to Rectangular
- Auxiliary Graphs
- Circles, Parabolas, Ellipses, Hyperbolas in Polar

Unit 5: Vectors

- Head, tail, magnitude
- Dot product
 - Cosine dot product theorem
- Cross product
 - Sine cross product theorem
- 3D Vectors, 3D lines
- Projections
- 3D planes
 - Normal vector
- Distance between points, planes, and lines.

Unit 6: Cycloids

- Parametric equations
- Graphing cycloids
 - Epicycloid, hypocycloid

Pre-Calc and Discrete Math

Unit 1: Counting

- Permutations and Combinations
- Nested sums
- Ball and Urn

Unit 2: Probability

- Basic and Conditional Probability
 - Probability trees
- Binomial Probability
- Poisson Probability
- Recursive Probability

Unit 3: Induction

- Proof by Induction
 - Basis step, inductive step
- Divisibility induction

- Mod function
- Sequences
 - Explicit formula, recursive formula

Unit 4: Limits

- Notation
- Removable discontinuities with limits
- End behavior

Unit 5: Graph Theory

- Traveling Salesperson
 - Cycles, total routes, unique routes, vertex, edge, optimal solution
 - Nearest neighbor method
 - Sorted edges method
 - Spanning trees
 - Prim's Algorithm
 - Christofides Algorithm
 - Eulerization

Unit 6: More Limits

- Secants and Tangents
- Instantaneous rate of change
- Difference quotient

AP Calculus BC

Unit 1:

- Limit Definition of a Derivative
- Power Rule
- Product Rule
- Quotient Rule
- Trig Derivatives
- Chain Rule
- Implicit Differentiation
- Linearization

Unit 2:

- Extreme Value Theorem
- Intermediate Value Theorem
- Mean Value Theorem
- End behavior
- Optimization
- Related Rates

Unit 3:

- Derivatives of inverses
- Derivatives of exponential functions
- Derivatives of logarithmic functions
- Derivatives of inverse trigonometry functions

Unit 4:

- Riemann Sums
- Definite Integrals, Indefinite Integrals
- Fundamental Theorem of Calculus
- U-substitution

Unit 5:

- L' Hospital's Rule
- Area between curves
- Volume of 3D solids
 - Disks, washers
 - Shells
- Integral applications

Unit 6:

- Integration by Parts
- Partial Fractions
- Improper Integrals
- Arc Length
- Trig Substitution

Unit 7:

- Slope Fields
- Euler's Method
- Separation of Variables
- Population Growth

- Logistic Growth, carrying capacity

Unit 8:

- Derivatives of parametric equations
- Vector calculus
 - Velocity, acceleration vectors, speed
- Polar Arc Length

Unit 9:

- N-th term test
- Comparison Test
- Integral Test
- Limit Comparison Test
- Alternating Series
 - Absolute Convergence
- Ratio Test

Unit 10:

- Power Series
 - Interval of convergence, radius of convergence, center
- Taylor and Maclaurin Series
- LaGrange Error Estimation

AP Computer Science

Textbook: Java Concepts Early Objects, Enhanced e-book, 9th edition

Chapters 1, 2, 3

- Constructors
 - Default constructor, parameterized constructors
- Methods
 - Notation, parameters, arguments, return values
- Overloading methods and constructors
- Implicit this
- Object references, instances

- Getter and setter methods

Chapter 4

- Primitives, classes
- Integer division, modulus, casting doubles to ints, powers
- Edge cases
- Usage of Epsilon when comparing doubles for equality

Chapter 5

- Operators
- Comparing floats
- Comparing strings
- DeMorgan's Law
- Short-Circuiting

Chapter 6

- For loops
- While loops
- Sentinel values
- Tracing

Chapter 7

- Nested loops
- Enhanced For loops
- Side Effects

Chapter 8,9

- Object oriented programming
- Polymorphism
- Abstraction
- Encapsulation
- Superclass
- Subclass
- Inheritance

Chapter 13

- Recursion
- Trace and write recursive methods
- Binary and Hexadecimal

- Tail recursion
- Helper methods

Chapter 14

- Selection Sort
- Bubble Sort
- Insertion Sort
- Merge Sort

Multivariable Calculus and Linear Algebra

Unit 1: Review

- Parametric Equations
- Calculus with Parametric Equations
- Polar
- Areas and Lengths in Polar
- Coordinates in 3D/Vectors
- Dot Product
- Cross Product
- Lines and Planes
- Cylinders and Quadric Surfaces

Unit 2: Partial Derivatives

- Functions of Several Variables
- Limits and Continuity
- Partial Derivatives
- Tangent Planes and Linear Approximations
- Chain Rule
- Directional Derivatives, Gradient Vectors
- Extrema
- LaGrange Multipliers

Unit 3:

- Double Integrals over Rectangles
- Double Integrals over General Regions
- Double Integrals in Polar
- Applications
- Surface Area
- Triple Integrals
 - Cartesian, Cylindrical, Spherical
- Change of Variables
- Center of Mass

Unit 4:

- Vector Functions and Space Curves
- Vector Fields
- Line Integrals
- Fundamental Theorem for Line Integrals
- Green's Theorem
- Curl and Divergence
- Parametric Surfaces and their Areas
- Surface Integrals
- Stokes' Theorem
- Divergence Theorem

Unit 5:

- Differential Equations
 - Second-order linear equations
 - Nonhomogeneous Linear Equations
 - Applications

End of MV, start of LA

Unit 1:

- Systems of Linear Equations
- Gaussian Elimination
- Matrix Operations
- Inverse and Properties of Matrices
- Elementary Matrices
- Linear Systems and Invertible Matrices
- Diagonal, Triangular, and Symmetric Matrices
- Formal Definition of Functions, Matrix Transformations
- Applications of Linear Systems

Unit 2

- Cofactor Expansion
- Row Reduction
- Determinant Properties and Cramer's Rule
- Vectors in n -space
- Norm, Dot Product, Distance in \mathbb{R}^n
- Orthogonality
- Geometry of Linear Systems
- Cross Product

Unit 3:

- Real Vector Spaces
- Subspaces
- Linear Independence
- Coordinates and Basis
- Change of Basis
- Row, Column, and Null Space
- Rank, Nullity

Revision #1

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