El Monte Union High School District
Course Outline

Course Title: Mathematical Reasoning with Connections (MRWC)

Textbook(s): MRWC Curriculum_____

Copyright date/Edition:_____

Transitional*_____(Eng. Dept. Only)

Sheltered (SDAIE)*_____Bilingual*___

AP**_____Honors**_____

Department:_____Math_____

CTE***:
   Industry Sector: _____

   Pathway: _____
(check one)
___Intro ___ Intermediate __Capstone

Grade Level (s):_____12_____

Semester_____Year__X_____

Year of State Framework Adoption_____

This course meets graduation requirements:

( )   English
( )   Fine Arts
( )   Foreign Language
( )   Health & Safety
(X)   Math
( )   Physical Education
( )   Science
( )   Social Science
( )   Elective

This course meets a-g requirements:
(_____) "a" – Social Studies
(_____) "b" – ELA
(__X_) "c" – Math
(_____) "d" – Lab Science
(_____) "e" – Language (not English)
(_____) "f" – Vis/Perf Arts
(_____) "g" – College prep elective

Department/Cluster Approval   Date

_____   _____

_____   _____

_____   _____

_____   _____

_____   _____

_____   _____

Is this course an adaptation from another source?
(_____) No
(__X___) Yes
If yes, please indicate the source of the original course:
_____CSU EAP

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*Instructional materials appropriate for English Language Learners are required.

**For AP/Honors course attach a page describing how this course is above and beyond a regular course. Also, explain why this course is the equivalent of a college level class.

***For CTE, attach the CTE course outline created in the online template (http://ctecourse.scoe.net/).

1. Prerequisite(s):

The prerequisite for MRWC is a minimum grade of C in Integrated Math III / Algebra 2.

2. Short description of course which may also be used in the registration manual:
▪ Objectives of course
▪ 3-5 sentences explaining overall course content
▪ Indicate references to state framework(s)/standards (If state standard is not applicable then national standards should be used)
▪ Student performance standards
▪ Evaluation/assessment/rubrics
▪ Include minimal attainment for student to pass course

The MRWC curriculum has been developed by a consortium of mathematics professors and math educators from CSU, UC, and CCC higher education systems, together with mathematics specialists from County Offices of Education and local school districts. It has been specifically designed to address the need for stronger mathematics preparation for transitioning from high school to college and career pathways.

Based on the Common Core State Standards viewpoint that mathematics is a cohesive and connected body of work, the MRWC is structured to highlight conceptual connections in the more advanced study of topics leading to calculus. Emphasis is given to conceptual understanding and making connections between numerical, symbolic, verbal, and graphical representations, discussion and analysis of alternative representations and multiple perspectives for approaching and understanding. The distinctiveness of MRWC lies in its unique design and topic sequencing, and in the emphasis on instructional delivery that promotes exploratory and collaborative student engagement. MRWC seamlessly interweaves the CCSS Mathematical Practices throughout the curriculum and develops key Habits of Mind and a mathematical disposition required for mastering advanced, challenging college-level content knowledge.

MRWC uses a non-traditional instructional approach emphasizing collaboration and exploration through mathematical activities, problem posing, and the use of technology that will address diverse learning styles. Instruction is designed to challenge students to approach mathematics as sense-making through a focus on questioning and probing deeper. Teacher-led instruction and student explorations will focus on discovering the conceptual basis for standard procedures. It will facilitate the development of students' ability to choose strategically among multiple solutions options, and to articulate the reasons for those decisions.   Students will use informal and formal justifications to defend their understandings and critique the reasoning of others. Instruction will emphasize the use of and fluency in the full range of the language of mathematics. Content topics will be approached through six instructional modalities i.e. verbal, numeric, symbolic, graphical, geometric, and technological.

3. Course content:
Number of units (minimum of 6): _____

Unit Title: _____Reasoning with Numbers_____
Content:

Students will extend their work with real and complex numbers. They will represent complex numbers in the Cartesian plane and interpret operations on complex numbers as geometric transformations. They will represent complex numbers in polar and trigonometric form and prove trigonometric identities for compound angles to find powers and roots of complex numbers.

Students will

1. Deepen their conceptual understanding of the relationships between and the structures of various subsets of numbers that make up the Complex Number System.

2. Find conjugates of complex numbers and use them to divide complex numbers.

3. Find moduli of complex numbers and relate them to distance and absolute value.

4. Represent complex numbers in the Cartesian (Argand) plane and describe the algebraic operations on complex numbers in terms of geometric transformations of translation, dilation, and rotation.

5. Connect complex numbers to vectors in the plane, and relate modulus of a complex number to length of a vector.

6. Relate scalar and vector multiplication to multiplication of complex numbers.

7. Represent complex numbers in polar and trigonometric forms and prove de Moivre's formula for multiplying and finding rational roots of complex numbers in trigonometric form.

8. Explore symmetries in the multiple roots of complex numbers and use the symmetries to explore infinite geometric sequences of complex numbers.

9. Prove that various subsets of the real and complex numbers are closed under different operations (including division, powers, and rooting).

10. Identify irrational numbers as limiting values of infinite sequences, including nested radicals and continued fractions.

11. Prove the existence and magnitude of numbers of irrational and complex numbers through geometric construction and algebraic proof.

Sample Assignment:

Culminating Project:

Different forms of formative and summative assessments will be used. Students will demonstrate their ongoing conceptual understanding and procedural fluency through mathematical activities, small group discussions and explorations, personal reflection quick writes, in addition to worksheets and individual written assessments such as quizzes, tests, final summative exams. Students will also be assessed through group projects, oral and written presentations.

Unit Title: __Reasoning with Functions_____
Content:

Students will explore commonalities across families of functions that include algebraic functions such as absolute value, root, polynomial, rational, and reciprocal, as well as transcendental functions such as exponential, logarithmic, and trigonometric. They will extend basic trigonometric functions to reciprocal and inverse trigonometric functions. Students will work with basic ellipses and hyperbolas and use translated and rotated axes to graph all conics in non-standard positions. They will graph advanced rational and piece-wise functions. They will identify zeros, multiple roots, intercepts, symmetries, vertical/horizontal, and slant asymptotes, holes, and end-behavior of functions. They will draw graphs using parametric equations. Students will develop fluency and flexibility with both the algebraic and geometric meaning and interpretation of functional notation. They will identify and find formulas of functions given in tables, graphs, and real-world situations.

Students will

1. Link patterns of real numbers to discrete functions, including arithmetic and geometric sequences and series.

2. Identify anomalies in the domain of continuous functions, including vertical asymptotes and removable points of discontinuity.

3. Use numeric limits and algebraic procedures to identify whether a number that is excluded from the domain is a removable point of discontinuity or a vertical asymptote.

4. Use numeric limits to explore function behavior on either side of a vertical asymptote.

5. Study key concepts related to functions including advanced study of domain and range, roots, symmetries and periodicity, positive/negative and increasing/decreasing.

6. Use algebraic factoring to predict function behavior based on multiplicity of roots and to find intervals on which functions are increasing/decreasing and positive/negative/constant.

7. Create functions given information about function features and behaviors.

8. Create functions in two or more variables that represent relationships between quantities expressed in verbal, numeric, or graphical form.

9. Use numeric limits and algebraic procedures to identify and describe the end behavior of a function, including limits at infinity, horizontal and slant asymptotes.

10. Study the graphs and features of reciprocal and inverse functions.

11. Relate features of reciprocal and inverse functions to understand trigonometric functions of cosecant, secant, cotangent, and the inverse trigonometric functions.

12. Use completing the square techniques to graph ellipses and hyperbolas in standard and non-standard positions.

13. Use trigonometric techniques to draw rotated conics.

14. Study parametric forms of equations and relate them to transformations.

15. Make connections between geometrical transformations (such as translation, rotation, reflections, dilations and stretches of graphs) and the algebraic process of function composition.

16. Expand composition to include composition of three or more functions.

17. Create new function graphs by composing functions given in graphical or tabular representations.

18. Decompose complicated functions into component functions, both graphically and algebraically.

19. Study basic properties of matrices and vectors.

20. Use vectors and matrices as a means to represent function transformations.

21. Use parametric equations to graph advanced functions.

22. Interpret function notation and function composition graphically, verbally, numerically and algebraically.

23. Use function notation to prove features of functions such as odd/even, increasing/decreasing, the existence of symmetry lines in parabolas and other conics.

Sample Assignment:
Culminating Project:

Different forms of formative and summative assessments will be used. Students will demonstrate their ongoing conceptual understanding and procedural fluency through mathematical activities, small group discussions and explorations, personal reflection quick writes, in addition to worksheets and individual written assessments such as quizzes, tests, final summative exams. Students will also be assessed through group projects, oral and written presentations.

Unit Title: Reasoning with Identities, Equations, and Inequalities
Content:

Sample Assignment:

Students will use underlying structure and the technique of u-substitution to simplify and solve advanced expressions, equations, and inequalities involving algebraic and trigonometric terms.

Students will

1. Prove/disprove identities among equivalent and non-equivalent expressions involving polynomial, rational, root, exponential, and logarithmic terms.

2. Prove/disprove trigonometric identities involving co-functions, compound/double/half angle formula.

3. Use similarity of triangles to develop sine and cosine and area formula for solving non-right triangles.

4. Develop fluency and flexibility in manipulating complicated forms of composite expressions and equations (including advanced factoring) by identifying and strategically using the idea of underlying structure.

5. Use advanced factoring techniques on expressions and equations involving binomials with rational exponents and terms with logarithmic and trigonometric exponents.

6. Solve advanced composite equations, inequalities, involving polynomial, rational, root, absolute value, trigonometric, exponential, and logarithmic expressions by identifying and strategically using underlying structure and alternative representations.

7. Identify and solve trigonometric equations and inequalities that have underlying structure of polynomial form using algebraic and graphical techniques.

8. Represent and solve systems of linear equations using matrices and a vector variable and use matrix inversion to solve.

9. Solve advanced systems of non-linear equations and inequalities involving roots, absolute value, exponentials, logarithms, and trigonometric terms.

10. Create equations in two or more variables to represent relationships between quantities using

11. Explore the geometry of polygons, curves, perimeter and area through equivalences such as similarity and congruence and transformations that preserve perimeter and/or area.

12. Study parallelism as an equivalence relation through two- and three-dimensional vectors.

Culminating Project:

Different forms of formative and summative assessments will be used. Students will demonstrate their ongoing conceptual understanding and procedural fluency through mathematical activities, small group discussions and explorations, personal reflection quick writes, in addition to worksheets and individual written assessments such as quizzes, tests, final summative exams. Students will also be assessed through group projects, oral and written presentations.

Unit Title: Reasoning with Distance
Content:

Building on knowledge of distance as an application of the Pythagorean Theorem, students will extend formulae to find distances in 3-dimensional space using algebraic and vector techniques. They will solve absolute value equations and inequalities by identify centers of intervals. Students will explore loci of curves and relate them to distances from foci in parabolas, ellipses, and hyperbolas. They will explore the effect of eccentricity as it relates to distance and the shapes of conics. They will identify similarities among conics by identifying the number of parameters involved in describing the conic. Students will relate regression to distance of the residuals. Students will link rate of change with a secant line, and investigate the derivative as the limiting case of the slope of a secant.

Students will

1. Extend the concept of distance as absolute value to find distances and midpoints between points in 3-dimensional space.

2. Find midpoints

3. Use the concept of loci to explore conics and other curves in algebraic and polar form.

4. Use real world data sets to connect the least square method of linear regression to the measurement of residuals as distances.

5. Extend the concept of distance to study slope, rate of change, and secant lines.

6. Explore the slope of a tangent line to a curve as the limiting case of the slope of a secant, and develop the concept of a derivative as a point.

Different forms of formative and summative assessments will be used. Students will demonstrate their ongoing conceptual understanding and procedural fluency through mathematical activities, small group discussions and explorations, personal reflection quick writes, in addition to worksheets and individual written assessments such as quizzes, tests, final summative exams. Students will also be assessed through group projects, oral and written presentations.

4. Describe how this course integrates the schools SLO (former ESLRs- Expected School-wide Learning Results):

5. Describe the Integrated ELD teaching techniques to be used to meet the needs of English Language Learners:

Students engage in the 6 recommended instructional practices designed to support English Learners within content area classes.
Students will engage in discipline specific practices to build their content knowledge;
Learning is anchored in real-world experiences;
Students' cultural and linguistic assets are valued, promoted and cultivated;
The course fosters team-based learning and student to student discussions;
Students get explicit instruction in discipline specific language and literacy through reading, writing, and discussion.

The Mathematical Practices encourage speaking and listening, language, reading, and writing, specifically MP1 (Make sense of problems and persevere in solving them – language and reading); MP3 (Construct viable arguments and critique the reasoning of others – language, speaking and listening, reading, writing) and MP6 (attend to precision – vocabulary, language, writing).

6. Describe the interdepartmental articulation process for this course:

The MRWC course is designed as a 4ᵗʰ year mathematics course that will prepare students for college-level mathematics, including pre-calculus, calculus, and other quantitative reasoning courses. The MRWC curriculum includes standards listed in the Precalculus Chapter of the Mathematics Framework and combines concepts of trigonometry, geometry, and algebra that lead to the study of calculus in a way that is substantively different from the traditional curriculum.

7. Describe how this course will integrate academic and vocational concepts, possibly through connecting activities. Describe how this course will address work-based learning/school to career concepts:
NA

8. Supplemental Materials of Instruction (Note: Materials of instruction for English Language Learners are required and should be listed below)

Type of material (book, manual, periodical, article, website, primary source document, etc.)	Author	Publisher	Edition/Year	URL	Primary book, read in its entirety? (Y/N)
MRWC curriculum	CSU	CSU			Y