Perris Union High School District
Course of Study

A. COURSE INFORMATION

Course Title:
(limited to 34 characters with spaces in Infinite Campus)

Mathematical Reasoning with Connections (MRWC)

- [x] New
- [ ] Revised

If revised, the previous course name if there was a change

Transcript Course Code/Number:

103121 & 103122

(To be assigned by Educational Services if it's a new course)

CREDIT TYPE EARNED: **CALPADS CODE:**

[x] Mathematics	9280

Subject Area:

- [ ] Social Science
- [ ] English
- [x] Mathematics
- [ ] Laboratory Science
- [ ] World Languages
- [ ] Visual or Performing Arts
- [x] College Prep Elective
- [ ] Other

Is this classified as a Career Technical Education course?

- [ ] Yes
- [x] No

If yes, which pathway does this course align to?
Pathway Name:

CTE CDE Code:

Grade Level(s)

- [ ] MS
- [ ] HS
- [ ] 5
- [ ] 6
- [ ] 7
- [ ] 8
- [ ] 9
- [ ] 10
- [ ] 11
- [x] 12

Was this course *previously approved by UC* for PUHSD?

- [ ] Yes
- [x] No

(Will be verified by Ed Services)

Which A-G Requirement does/will this course meet?

C	[ ] Pending

Credential Required to teach this course:
To be completed by Human Resources only

Single Subject: Mathematics

Signature **Date** 05/23/2024

Submitted by:
Site:
Date:
Email:

Unit Value/Length of Course:

- [ ] 0.5 (half-year or semester equivalent)
- [x] 1.0 (one-year equivalent)
- [ ] 2.0 (two-year equivalent)
- [ ] Other:

Approvals	Name/Signature	Date
Director of Curriculum & Instruction		05/23/24
Asst. Superintendent of Educational Services	K Rdg Lee Mackamul	5/23/24
Governing Board		

Prerequisite(s) (REQUIRED):

C or better in Algebra 2.

Corequisite(s) (REQUIRED):

None.

Brief Course Description (REQUIRED):

Mathematical Reasoning with Connections (MRWC) is a fourth year high school mathematics course designed to prepare students for the expectations and rigor of college mathematics courses. It reinforces and builds on mathematical topics and skills developed in Integrated Math (IM) 1-3 (or Algebra 1-2 and Geometry) and prepares students for mathematics courses required in either STEM and non-STEM majors.

B. COURSE CONTENT

Course Purpose (REQUIRED):
What is the purpose of this course? Please provide a brief description of the goals and expected outcomes. Note: More specificity than a simple recitation of the State Standards is needed.

The MRWC is a rigorous and challenging college prep mathematics course that satisfies the a-g requirements with a "c" for Advanced Mathematics. It serves as a bridge to both STEM and non-STEM pathways, restructuring the traditional curriculum to provide a fully integrated and cohesive learning experience. MRWC can replace Precalculus or serve as a bridge to Calculus, focusing on conceptual development to promote procedural fluency. It incorporates the Standards for Mathematical Practice (SMP) in every activity and encourages collaborative learning and group discussions.

Several key principles underlie the Mathematical Reading with Connections course curriculum and its materials:

- Connectedness between overarching themes in mathematics that underlie many topics in high school curriculum.
- Interrelated nature of procedural and conceptual knowledge as well as problem solving and reasoning abilities highlighted throughout the MRWC curriculum.
- Emphasis on discussion and analysis of alternative representations and multiple perspectives for approaching and understanding content to enhance flexibility and fluidity with the applications of procedures.
- Classroom activities designed to model and foster real life applications of the advanced mathematical concepts.
- Topics and activities that promote exploratory and collaborative student engagement.
- Modular format of curricular materials that allows for flexible implementation in various settings or replacing existing curriculum as well as responding to the varied needs of students.
- Alignment to the Common Core Standards for Mathematical Practice.

Course Outline (REQUIRED):
Detailed description of topics covered. All historical knowledge is expected to be empirically based, give examples. Show examples of how the text is incorporated into the topics covered.

Theme 1: Reasoning with Numbers

Students will explore the development of the Number System up through complex numbers. The mathematical idea of closure will provide a logical structure for the construction, expansion, and organization of the sets of numbers.

Students will gain a deeper, more conceptual interpretation of each major subset (Natural, Integers, Rationales, Irrationals, Real, and Complex) of the Number System by considering three questions:

- What evidence is there that these numbers exist and are needed for subsequent understanding and production in mathematics?
- If these numbers exist, where are they positioned on the real number line or in the complex plane?
- How do the standard operations change in meaning and properties as the set of numbers is expanded?

In answering these questions, students will explore the link between numerical symbols, algebraic representations, geometric construction, transformations, and concepts of limits as tools for understanding numbers and their behaviors and the rules that govern their use.

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.

Theme 2: Reasoning with Functions.

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. 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.

Theme 3: Reasoning with Identities, Equations, and Inequalities.

Students will explore mathematical properties and characteristics of basic algebraic and geometric entities in order to develop generalizations that can be applied to more complex situations. The mathematical idea of equivalence will provide the logical structure for manipulating expressions, solving equations and inequalities, and studying geometrical figures. 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. 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.

Theme 4: Reasoning with Distance.

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 identifying 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.

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5. Extend the concept of distance to study slope, rate of change, and secant lines.
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INSTRUCTIONAL MATERIALS (REQUIRED)	
Textbook #1	
Title: MRWC Teacher Manual	Edition:
Author: CSU	ISBN:
Publisher: CSU	Publication Date:
Usage: ☑ Primary Text ☐ Read in entirety or near	
Textbook #2	
Title: Student Activity Notebook	Edition:
Author: CSU	ISBN:
Publisher: CSU	Publication Date:
Usage: ☐ Primary Text ☑ Read in entirety or near	

Supplemental Instructional Materials *Please include online, and open source resources if any.*	
Mathematical puzzles and games.	
Estimated costs for classroom materials and supplies (REQUIRED). *Please describe in detail.* If more space is needed than what is provided, please attach a backup as applicable.	
Cost for a class set of textbooks: $	Description of Additional Costs:
Additional costs:$	
Total cost per class set of instructional materials:	$

Key Assignments (REQUIRED):

Please provide a detailed description of the Key Assignments including tests, and quizzes, which should incorporate not only short answers but essay questions also. How do assignments incorporate topics? Include all major assessments that students will be required to complete

Theme 1: Reasoning with Numbers

Students will:

- Extend their work with real and complex numbers.
- Represent complex numbers in the Cartesian plane and interpret operations on complex numbers as geometric transformations.
- Represent complex numbers in polar and trigonometric form and prove trigonometric identities for compound angles to find powers and roots of complex numbers.

Theme 2: Reasoning with Functions.

Students will:

- Extend basic trigonometric functions to reciprocal and inverse trigonometric functions.
- Work with basic ellipses and hyperbolas and use translated and rotated axes to graph all conics in non-standard positions.
- Graph advanced rational and piecewise functions.
- Identify zeros, multiple roots, intercepts, symmetries, vertical/horizontal, and slant asymptotes, holes, and end-behavior of functions.
- Draw graphs using parametric equations.

Theme 3: Reasoning with Identities, Equations, and Inequalities.

Students will:

- Identify equivalent and non-equivalent expressions involving polynomial, rational, root, trigonometric, exponential, and logarithmic terms.
- Solve complex equations, inequalities, and systems of equations and inequalities involving polynomial, rational, root, absolute value, trigonometric, exponential, and logarithmic expressions by identifying and strategically using the ideas of underlying structure and alternative representations.
- Explore the geometry of polygons, curves, perimeter and area through equivalences such as similarity and congruence and transformations that preserve perimeter and/or area.

Theme 4: Reasoning with Distance.

Starting with the notion of distance as a function.

Students will:

- Study distance between two real numbers in a line as absolute value and use the Pythagorean theorem to extend this concept to the distance of points in space.
- Use the concept of loci to explore conics and other curves in algebraic and polar form.
- Use real world data sets to connect the least square method of linear regression to the measurement of residuals as distances.
- Extend the concept of distance to study slope, rate of change, secant lines, limits, and tangent lines of functions.

Instructional Methods and/or Strategies (REQUIRED):

Please list specific instructional methods that will be used.

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.

- Teacher instruction will 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.
- Teacher Instruction 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 understanding and critique the reasoning of others.
- Teacher Instruction will emphasize the use of and fluency in the full range of the language of mathematics.
- Course themes will be approached through six instructional modalities i.e. verbal, numeric, symbolic, graphical, geometric, and technological.

Assessment Methods and/or Tools (REQUIRED):

Please list different methods of assessments that will be used.

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,
- worksheets and individual written assessments quizzes,
- tests, and
- final summative exams.
- Students will also be assessed through group projects, oral and written presentations.

COURSE PACING GUIDE AND OBJECTIVES (REQUIRED)				
Day(s)	**Objective**	**Standard(s)**	**Chapter(s)**	**Reference**

C. HONORS COURSES ONLY
Indicate how much this honors course is different from the standard course.
n/a

D. BACKGROUND INFORMATION

Context for course (optional)

- https://www.cpp.edu/academic-programs/eap/docs/mrwc-overview-2019-20.pdf
- https://bridgecourses.calstate.edu/mathematical-reasoning-connections
- https://www.rcoe.us/departments/educational-services/instructional-services/i3-mathematical-reasoning-with-connections
- https://youtu.be/QcKNGa4ZEPQ?si=M4pHpNKEmoYddqGm
- https://web.csulb.edu/divisions/students/eap/mrwc.html

History of Course Development (optional)

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 understanding 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.