Mathematics Curriculum Map

Multivariable Calculus and Differential Equations

Chandler Unified School District Standards

Multivariable Calculus and Differential Equations – At a Glance

NOTE: Mathematical standards are interwoven and should be addressed throughout the year in as many different units and tasks as possible in order to stress the natural connections that exist among mathematical topics.

Multivariable Calculus and Differential Equations Curriculum Map

Semester 1				Semester 2			
Unit 1 Vectors and Vector Valued Functions	**Unit 2 Functions of Several Variables and Partial Differentiation**	**Unit 3 Multiple Integrals**	**Unit 4 Vector Fields and Line Integrals**	**Unit 5 First Order Solving Methods**	**Unit 6 Higher Order Solving Methods**	**Unit 7 Transform and Series Methods**	**Unit 8 Matrix Methods for Linear Systems**
MCCD OCC 1 MCCD OCC 2 MCCD OCC 4 MCCD OCC 8 MCCD OCC 9	MCCD OCC 3 MCCD OCC 4 MCCD OCC 5 MCCD OCC 8 MCCD OCC 9	MCCD OCC 4 MCCD OCC 6 MCCD OCC 8 MCCD OCC 9	MCCD OCC 7 MCCD OCC 8 MCCD OCC 9	MCCD OCC 1 MCCD OCC 3 MCCD OCC 5 MCCD OCC 6 MCCD OCC 7 MCCD OCC 8	MCCD OCC 1 MCCD OCC 3 MCCD OCC 5 MCCD OCC 6 MCCD OCC 7 MCCD OCC 8	MCCD OCC 1 MCCD OCC 2 MCCD OCC 3 MCCD OCC 5 MCCD OCC 6 MCCD OCC 7 MCCD OCC 8	MCCD OCC 2 MCCD OCC 3 MCCD OCC 4 MCCD OCC 5 MCCD OCC 6 MCCD OCC 7 MCCD OCC 8

Standards are Based on the MCCCD Official Course Competencies

Multivariable Calculus and Differential Equations Overview

MCCCD Official Course Competencies Multivariable Calculus

1. Solve geometry and physics problems using vectors.

2. Analyze the motion of an object using vector-valued functions.

3. Classify and analyze the behavior of functions of several variables.

4. Interpret the geometry of rectangular, polar, cylindrical and spherical coordinate systems.

5. Solve optimization and other applied problems using partial derivatives.

6. Set up and compute double and triple integrals in any order of integration using rectangular, polar, cylindrical, and spherical coordinates.

7. Solve physical problems using line integrals and vector fields.
8. Compare alternate solution strategies, including technology.

9. Communicate process and results in written and verbal formats.

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MCCCD Official Course Competencies Differential Equations

1. Solve analytically and numerically ordinary differential equations, primarily of first or second order, using exact, implicit, or discrete approximation solution types

2. Solve analytically and numerically systems of ordinary linear differential equations using matrix methods and Laplace Transforms or differential operator methods.

3. Solve application problems using differential equations.

4. Linearize non-linear systems and describe the long-term behavior of solutions.

5. Read and interpret quantitative information when presented numerically, analytically or graphically.

6. Compare alternate solution strategies, including technology.

7. Justify and interpret solutions to application problems.

8. Communicate process and results in written and verbal formats.

Semester 1

Unit 1 - Vectors and Vector Valued Functions

Essential Question(s):

- **How do we represent three dimensional paths and surfaces using vectors?**

Topic	MCCCD Core Competencies	Resources
Vector Definitions	MCCCD Course Competencies #1 Solve geometry and physics problems using vectors. MCCCD Course Competencies #2 Analyze the motion of an object using vector-valued functions. MCCCD Course Competencies #4 Interpret the geometry of rectangular, polar, cylindrical and spherical coordinate systems. MCCCD Course Competencies #8 Compare alternate solution strategies, including technology. MCCCD Course Competencies #9 Communicate process and results in written and verbal formats.	Smith and Minton 10.1 Larson 11.1
Vector Operations and Properties		Smith and Minton 10.1,10.2,10.3,10.4 Larson 11.1,11.2,11.3,11.4
Vector Representations of Lines and Plane		Smith and Minton 10.5, 10.6 Larson 11.5
Vector Applications		Smith and Minton Chapter 10 (throughout) Larson Chapter 11
Vector-Valued Functions: Definitions and Representations		Smith and Minton 11.1 Larson 12.1
Limits of Vector-Valued Functions		Smith and Minton 11.2 Larson 12.1
Derivatives of Vector-Valued Functions		Smith and Minton 11.2 Larson 12.2
Integrals of Vector-Valued Functions		Smith and Minton 11.2 Larson 12.2
Applications of Vector-Valued Functions		Smith and Minton 11.4, 11.6 Larson 12.3

Semester 1

Unit 2 - Functions of Several Variables and Partial Differentiation

Essential Question(s):

- **How do we analyze functions of several variables, and how do we find minimums and maximums of these functions?**

Topic	MCCCD Core Competencies	Resources
Representing Surfaces	MCCCD Course Competencies #3 Classify and analyze the behavior of functions of several variables. MCCCD Course Competencies #4 Interpret the geometry of rectangular, polar, cylindrical and spherical coordinate systems. MCCCD Course Competencies #5 Solve optimization and other applied problems using partial derivatives. MCCCD Course Competencies #8 Compare alternate solution strategies, including technology. MCCCD Course Competencies #9 Communicate process and results in written and verbal formats.	Smith and Minton 12.1 Larson 13.1
Limits and Continuity		Smith and Minton 12.2 Larson 13.2
Partial Derivatives and Applications		Smith and Minton 12.3, 12.4, 12.5, 12.6 Larson 13.3,13,4,13.5,13.6
Optimization		Smith and Minton 12.7, 12.8 Larson 13.7,13.8,13.9

Semester 1

Unit 3 – Multiple Integrals
Essential Question(s):

- **How can we represent multiple integrals in different forms?**

Topic	MCCCD Core Competencies	Resources
Visualizing the Domain of Integration	MCCCD Course Competencies #4 Interpret the geometry of rectangular, polar, cylindrical and spherical coordinate systems. MCCCD Course Competencies #6 Set up and compute double and triple integrals in any order of integration using rectangular, polar, cylindrical, and spherical coordinates. MCCCD Course Competencies #8 Compare alternate solution strategies, including technology. MCCCD Course Competencies #9 Communicate process and results in written and verbal formats.	Smith and Minton 13.1 Larson 14.1
Order of Integration		Smith and Minton 13.1, 13.2, 13.5 Larson 14.2,14.6
Change of Variables		Smith and Minton 13.3, 13.6, 13.7, 13.8 Larson 14.3,14.7,14.8
Applications of Multiple Integrals		Smith and Minton 13.4 Larson 14.4,14.5

Semester 1 **Unit 4 – Vector Fields and Line Integrals** **Essential Question(s):** • **What is a line integral, and how can we use theorems to help us solve for them?**		
Topic	**MCCCD Core Competencies**	**Resources**
Definitions of Vector Fields and Line Integrals	MCCCD Course Competencies #7 Solve physical problems using line integrals and vector fields. MCCCD Course Competencies #8 Compare alternate solution strategies, including technology. MCCCD Course Competencies #9 Communicate process and results in written and verbal formats.	Smith and Minton 14.1 Larson 15.1
Properties of Vector Fields and Line Integrals		Smith and Minton 14.2 Larson 15.2
Applications of Vector Fields and Line Integrals		Smith and Minton 14.3, 14.4 Larson 15.3,15.4
Surface Integrals		Smith and Minton 14.6 Larson 15.5,15.6
Volume Integrals		Smith and Minton 14.7, 14.8 Larson 15.7,15.8

Semester 2

Unit 5 – First Order Solving Methods
Essential Question(s):

- **What are specific methods to solve first order differential equations, and how do we know when to use each method?**

Topic	MCCCD Core Competencies	Resources
First Order Equations	MCCCD Course Competencies #1 Solve analytically and numerically ordinary differential equations, primarily of first or second order, using exact, implicit, or discrete approximation solution types. MCCCD Course Competencies #3 Solve application problems using differential equations. MCCCD Course Competencies #5 Read and interpret quantitative information when presented numerically, analytically or graphically. MCCCD Course Competencies #6 Compare alternate solution strategies, including technology. MCCCD Course Competencies #7 Justify and interpret solutions to application problems. MCCCD Course Competencies #8 Communicate process and results in written and verbal formats.	Nagle Chapters 2 and 3

Semester 2

Unit 6 – Higher Order Solving Methods

Essential Question(s):

- **How do we solve second and higher order differential equations?**

Topic	MCCCD Official Course Competencies	Resources
Second Order Differential Equations	MCCCD Course Competencies #1 Solve analytically and numerically ordinary differential equations, primarily of first or second order, using exact, implicit, or discrete approximation solution types. MCCCD Course Competencies #3 Solve application problems using differential equations. MCCCD Course Competencies #5 Read and interpret quantitative information when presented numerically, analytically or graphically. MCCCD Course Competencies #6 Compare alternate solution strategies, including technology. MCCCD Course Competencies #7 Justify and interpret solutions to application problems. MCCCD Course Competencies #8 Communicate process and results in written and verbal formats.	Nagle Chapters 4
Higher Order Differential Equations		Nagle Chapter 6

Semester 2

Unit 7- Transform and Series Solutions
Essential Question(s):

- **How do Laplace Transforms and Series help us solve differential equations?**

Topic	MCCCD Official Course Competencies	Resources
Laplace Transform Series Solutions	MCCCD Course Competencies #1 Solve analytically and numerically ordinary differential equations, primarily of first or second order, using exact, implicit, or discrete approximation solution types. MCCCD Course Competencies #2 Solve analytically and numerically systems of ordinary linear differential equations using matrix methods and Laplace Transforms or differential operator methods. MCCCD Course Competencies #3 Solve application problems using differential equations. MCCCD Course Competencies #5 Read and interpret quantitative information when presented numerically, analytically or graphically. MCCCD Course Competencies #6 Compare alternate solution strategies, including technology. MCCCD Course Competencies #7 Justify and interpret solutions to application problems. MCCCD Course Competencies #8 Communicate process and results in written and verbal formats.	Nagle Chapters 7,8

Semester 2

Unit 8 – Matrix Methods for Linear Systems

Essential Question(s):

- **How do we use matrices to represent and solve differential equations?**

Topic	MCCCD Official Course Competencies	Resources
Matrices Eigenvalues and Eigenvectors	MCCCD Course Competencies #2 Solve analytically and numerically systems of ordinary linear differential equations using matrix methods and Laplace Transforms or differential operator methods. MCCCD Course Competencies #3 Solve application problems using differential equations. MCCCD Course Competencies #4 Linearize non-linear systems and describe the long-term behavior of solutions. MCCCD Course Competencies #5 Read and interpret quantitative information when presented numerically, analytically or graphically. MCCCD Course Competencies #6 Compare alternate solution strategies, including technology. MCCCD Course Competencies #7 Justify and interpret solutions to application problems. MCCCD Course Competencies #8 Communicate process and results in written and verbal formats.	Nagle Chapter 9