Required Syllabus Information – all must be included in the course syllabus

MAT 203
Course Title: Calculus III: MA1
Course Credits: 4
Course Description: Focuses the traditional subject matter of multivariable Calculus. Topics include vectors, vector-valued functions, partial derivatives, analytic geometry, multiple integrals, line integrals and applications.

GT Pathways Requirements:

Guaranteed Transfer (GT) Pathways Course Statement:
The Colorado Commission on Higher Education has approved MAT 203 for inclusion in the Guaranteed Transfer (GT) Pathways program in the GT- MA1 category. For transferring students, successful completion with a minimum C– grade guarantees transfer and application of credit in this GT Pathways category. For more information on the GT Pathways program, go to http://highered.colorado.gov/academics/transfers/gtpathways/curriculum.html.

MATHEMATICS CONTENT CRITERIA GT-MA1

a) Demonstrate good problem-solving habits, including:
   - Estimating solutions and recognizing unreasonable results.
   - Considering a variety of approaches to a given problem, and selecting one that is appropriate.
   - Interpreting solutions correctly.
b) Generate and interpret symbolic, graphical, numerical, and verbal (written or oral) representations of mathematical ideas.
c) Communicate mathematical ideas in written and/or oral form using appropriate mathematical language, notation, and style.
d) Apply mathematical concepts, procedures, and techniques appropriate to the course.
e) Recognize and apply patterns or mathematical structure.
f) Utilize and integrate appropriate technology.

COMPETENCIES & STUDENT LEARNING OUTCOMES FOR GT-MA1

Quantitative Literacy:

1. **Interpret Information**
   a. Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).
2. **Represent Information**
   a. Convert information into and between various mathematical forms (e.g., equations, graphs, diagrams, tables, words).
3. **Perform Calculations**
   a. Solve problems or equations at the appropriate course level.
   b. Use appropriate mathematical notation.

c. Solve a variety of different problem types that involve a multi-step solution and address the validity of the results.

4. **Apply and Analyze Information**
    a. Make use of graphical objects (such as graphs of equations in two or three variables, histograms, scatterplots of bivariate data, geometrical figures, etc.) to supplement a solution to a typical problem at the appropriate level.
    b. Formulate, organize, and articulate solutions to theoretical and application problems at the appropriate course level.
    c. Make judgments based on mathematical analysis appropriate to the course level.
5. **Communicate Using Mathematical Forms**
    a. Express mathematical analysis symbolically, graphically, and in written language that clarifies/justifies/summarizes reasoning (may also include oral communication).

SYSTEM REQUIREMENTS:

REQUIRED COURSE LEARNING OUTCOMES

1. Apply vector algebra to the geometry of space.
2. Analyze 2 and 3 dimensional curves given as vector valued functions using calculus techniques.
3. Examine surfaces/multivariable functions and their graphs using calculus techniques.
4. Construct multiple integrals for regions in the plane and space using rectangular, polar, cylindrical, and spherical coordinates to measure areas, volumes, and other applications.
5. Evaluate double and triple integrals.
6. Determine vector field properties.
7. Apply theorems of vector calculus, such as Fundamental Theorem of Line Integrals and Green's Theorem.

REQUIRED TOPICAL OUTLINE

I. Apply vector algebra to the geometry of space.
    a. Vector addition and subtraction, geometrically and algebraically
    b. Properties of vectors in 2 and 3 dimensional space
    c. Dot product, cross product, and projection
    d. Applications of the dot and cross products
    e. Distances in 3-space

II. Analyze 2 and 3 dimensional curves given as vector valued functions using calculus techniques.
    a. Graph curves given in vector valued form
    b. Construct a vector valued function for a given curve
    c. Evaluate limits
    d. Determine continuity and smoothness
    e. Differentiate and integrate vector valued functions
    f. Parametric and symmetric forms of a line
    g. Find the unit tangent and unit normal vectors of a curve
    h. Examine applications of vector valued functions

i. Find arc length and curvature
j. Projectile motion

III. Examine surfaces/multivariable functions and their graphs using calculus techniques.
a. Graph cylinders and quadric surfaces
b. Graphs of lines and planes in 3 dimensional space
c. Graph cylindrical and spherical coordinates and surfaces
d. Construct level curves and level surfaces
e. Graph a surface given in parametric form
f. Limits and continuity of functions and surfaces
g. Find the domain of surfaces/multivariable functions
h. Evaluate limits using the definition and theorems
i. Find partial derivatives and directional derivatives
j. Use the chain rule
k. Use implicit differentiation
l. Differentials
m. Find the gradient
n. Find the tangent plane and normal line
o. Optimization of surfaces using calculus
p. Show differentiability of a multivariable function

IV. Construct multiple integrals for regions in the plane and space using rectangular, polar, cylindrical, and spherical coordinates to measure areas, volumes, and other applications.
a. Transform equations of surfaces between rectangular, cylindrical and spherical forms
b. Transform double integrals between rectangular and polar
c. Transform triple integrals between rectangular, cylindrical and spherical
d. Evaluate double and triple integrals
e. Evaluate iterated integrals
f. Change the order of integration in a double or triple integral
g. Determine vector field properties
h. Conservative vector fields
i. Find curl
j. Find divergence

V. Apply theorems of vector calculus, such as Fundamental Theorem of line integrals and Green's Theorem.
a. Evaluate a line integral
b. Evaluate a line integral in a vector field
c. Use the Fundamental Theorem of line integrals
d. Use independence of path
e. Use Green's Theorem
f. Evaluate a surface integral
g. Evaluate a surface integral in a vector field
h. Find work done in a vector field using theorems related to line integrals
i. Find flux in a vector field using theorems related to surface integrals

RECOMMENDED TOPICAL OUTLINE

I. Find equations or vector valued functions for surfaces.
a. Construct the equation of a surface of revolution

b. Construct a vector valued function for a given surface, with the necessary domain

CCCOnline Course Policies: http://www.ccconline.org/ccconline-course-policies/

Effective Implementation date: Spring 2018, 201830