COLORADO
COMMUNITY COLLEGE SYSTEM

GT-MA1: Mathematics
Required Syllabus Information

Course Prefix and Number: MAT 255
Course Title: Linear Algebra
Course Credits: 3
Course Description: Introduces linear algebra and emphasizes techniques of problem solving and introductory proofs. This course includes linear systems, matrices, determinants, vector spaces, linear transformations, eigenvalues, and eigenvectors.

Guaranteed Transfer (GT) Pathways Course Statement:
The Colorado Commission on Higher Education has approved MAT255 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. This course is one of the Statewide Guaranteed Transfer courses. For more information on the GT Pathways program, go to https://highered.colorado.gov/academics/transfers/gtpathways/curriculum.html.

GT-MA1: MATHEMATICS CONTENT CRITERIA
Students should be able to:

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.

GT-MA1 COMPETENCY & STUDENT LEARNING OUTCOMES
Competency: Quantitative Literacy:
Students should be able to:

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).

REQUIRED COURSE LEARNING OUTCOMES

1. Solve linear systems using the elimination method, determinants of matrices, and inverse matrices.
2. Perform basic operations of matrix algebra.
3. Analyze determinants.
4. Analyze vector spaces.
5. Analyze linear transformations.
6. Compute eigenvalues and eigenvectors.
7. Construct formal mathematical proofs.

REQUIRED TOPICAL OUTLINE

I. Linear systems using the elimination method, determinants of matrices, and inverse matrices

a. Coefficient matrices and augmented matrices

b. Elementary row operations

c. Row echelon form and reduced row echelon form

d. Gauss elimination and Gauss-Jordan elimination

e. Determinants of matrices and Cramer's Rule

f. Elementary matrices

g. Inverse matrices

h. Linear dependence and linear independence

II. Basic operations of matrix algebra

a. Matrix addition and subtraction

b. Matrix multiplication and scalar product of a matrix

c. Vector dot product

d. Transpose of a matrix

III. Determinants

a. Calculation of determinants

b. Properties of determinants

c. Equivalency statements involving determinants and nonsingular matrices

IV. Vector spaces

a. Definition of vector spaces

b. Proofs that a set with given operations is or isn't a vector space

c. Lines and planes in three dimensional space

d. Subspaces, dimensions, and bases

e. Spanning set

f. Row space, column space, null space, rank

g. Linear combination of vectors

V. Linear transformations

a. Definition of linear transformations

b. Transformation from one basis to another

c. Kernel and range of a linear transformation

d. Composition of linear transformations

e. Representations of a vector with respect to a given basis

VI. Eigenvalues and eigenvectors

a. Similar matrices

b. Applications of eigenvalues and eigenvectors

c. Eigenspaces

d. Diagonalization of a matrix

VII. Formal mathematical proofs

a. Various proof methods such as direct proofs, proof by contradiction, or proof by contrapositive

LEGAL COMPLIANCE
Effective Implementation date: Summer 2019, 201830