### Georgia Perimeter College
#### Common Course Outline

<table>
<thead>
<tr>
<th>Course Abbreviation &amp; Number:</th>
<th>Math 2641</th>
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<tbody>
<tr>
<td>Course Title:</td>
<td>Linear Algebra</td>
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<tr>
<td>Credit Hours:</td>
<td>3</td>
</tr>
<tr>
<td>Prerequisites:</td>
<td>None</td>
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<tr>
<td>Co-requisites:</td>
<td>Math 2432</td>
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</tbody>
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**Course Description:**

This course is designed to introduce the student to the basic notions of linear algebra. Topics include matrices, systems of linear equations, vector spaces, inner products, bases, linear transformations, eigenvalues, and eigenvectors.

**Expected Educational Results:**

As a result of completing this course, the student will be able to do the following:

1. Use Gauss-Jordan Elimination to solve systems of linear equations and identify those with one solution, no solution, or an infinite number of solutions.
2. Perform operations with matrices, namely,
   a) Matrix addition and subtraction,
   b) Scalar multiplication,
   c) Transposition,
   d) Matrix multiplication,
   e) Matrix inversion, and
   f) Calculation of rank and determinant.
3. Solve problems that require that the student demonstrate comprehension of fundamental properties of the above operations including, but not limited to,
   a) Axioms for matrix addition and scalar multiplication,
   b) Laws for transposes of matrix sums, products, and scalar multiples,
   c) Laws for inversion of matrix transposes, products, and scalar multiples,
d) Laws for determinants of matrix products, inverses, and transposes,
e) Significance of the determinant of a matrix yielding zero, and
f) Significance of the product of two matrices yielding the identity.

4. Demonstrate comprehension of fundamental definitions used in the study of linear algebra by determining whether or not
a) A subset is a subspace of a given vector space,
b) A vector lies in the span of a given set of vectors and, if so, express that vector as a linear combination of the others,
c) A set of vectors is linearly independent,
d) A set of vectors forms a basis of a given vector space or subspace,
e) A vector function is a linear transformation, and
f) A linear transformation is on-to-one, onto, or an isomorphism.

5. Actively use the above definitions to obtain
a) A basis for and calculation of the dimension of a given vector space or subspace,
b) A linear transformation that satisfies given properties and a computation of the action of that transformation on a given vector,
c) A basis for the kernel, a basis for the image, the nullity, and rank of a given linear transformation,
d) The action of the composition of two given linear transformations (in either order) on a given vector, and
e) The inverse transformation of a given isomorphism and its action on a given vector.

6. Using an appropriate inner product, obtain
a) The norm of a given vector,
b) The unit vector that is a scalar multiple of a given vector,
c) A basis for and calculation of the dimension of the orthogonal complement of a given subspace,
d) The projection of a given vector onto a given subspace,
e) An orthogonal basis for a given inner product space or subspace,

f) An orthonormal basis by normalizing an orthogonal basis.

7. Obtain the characteristic polynomial, eigenvalues, eigenvectors, diagonalization, and a basis for each eigenspace for a given square matrix.

8. Use least-squares methods to approximate solutions for inconsistent systems.

9. Apply the basic definitions for quadratic forms.

General Educational Outcomes:

1. Students produce well-organized communication that exhibit logical thinking and organization, use appropriate style for audience and meet conventional standards of usage.
A. Students develop their listening and speaking skills through participation in class and through group problem solving.

B. Students develop their reading comprehension skills by reading the text and by reading the instructions for text exercises, problems on tests, or on projects. Reading mathematics text requires recognizing symbolic notation as well as analyzing problems written in prose.

C. Students develop their writing skills through the use of problems that require written explanations of concepts.

II. Students demonstrate effective problem-solving and critical thinking skills through interpreting, presenting or evaluating ideas.

A. Students must apply mathematical concepts previously mastered to new problems and situations.

B. In applications, students must analyze problems and describe problems with either pictures, diagrams, or graphs, then determine the appropriate strategy for solving the problem.

III. Students demonstrate the ability to interpret and analyze quantitative information; apply mathematical principles and techniques; and to use mathematical models to solve applied problems.

A. Students must demonstrate proficiency in problem-solving skills including applications of linear systems, linear transformations and vector space methods.

B. Students must write linear systems to describe real-world situations and interpret information about the number of solutions as well as the solution of the systems themselves.

C. Students must solve systems of linear equations which often arise in modeling numerical relationships.

**Course Content:**

| Topics include matrices, systems of linear equations, vector spaces, inner products, bases, linear transformations, eigenvalues, and eigenvectors. |

**Assessment of Outcome Objectives**

| Course Grade: |
| The course grade will be determined by the individual instructor using a variety of evaluation methods. A portion of the course grade will be determined through the use of frequent assessment using such means as tests, quizzes, projects, or homework as developed by the instructor. Some of these methods will require the student to demonstrate ability in problem solving and critical thinking as |
evidenced by explaining and interpreting solutions. A comprehensive final examination is required which must count at least one-fifth and no more than one-third of the course grade.

### Course Assessment:

A. This course will be assessed in the fall semester on a three-year assessment cycle. Objective questions assessing student mastery of outcomes for this course will be included in either the final exam or unit tests for this course. Each instructor must include these questions in the appropriate exam. Each instructor is responsible for reviewing and tabulating the results of these outcome assessment questions and transmitting them to the course or curriculum committee responsible for this course. Individual instructors should use feedback from assessment in their classes to review and evaluate their own teaching practices.

B. The construction of the outcome assessment questions will be the responsibility of the college-wide Math 2420/2641/2652 Curriculum Committee.

### Use of Assessment Findings:

The Math 2420/2641/2652 Curriculum Committee will meet in the spring term after the fall assessment to review the course and to evaluate the results. The review of the course outcome assessment findings will provide information on success in achieving the desired outcomes for this course on a college-wide basis. If fewer than 70% of the students perform successfully on questions measuring any particular educational outcome, the committee will examine teaching practices related to that outcome, the assessment instrument, and the desired learning outcomes to determine which, if any, of these need modifying. The committee will share its findings and recommendations with all faculty teaching this course, and may make changes to the desired educational outcomes, teaching practices, or assessment instrument as appropriate.

### Last Revised:

April 2015