Degree Applicable
Course ID 0033251

Glendale Community College
May 2016

COURSE OUTLINE

Math 107 (C-ID Number: Math 250)
Linear Algebra (C-ID Name: Introduction to Linear Algebra)

Catalog Statement

MATH 107 covers the topics of vector spaces, linear transformations and matrices, matrix algebra, determinants, eigenvalues and eigenvectors, and solutions of systems of equations. Solution techniques include row operations, Gaussian elimination and matrix algebra. Specific topics in vector spaces and matrix theory include inner products, norms, orthogonality, eigenvalues, eigenspaces, linear transformations and applications.

Total Lecture Units: 5.0
Total Laboratory Units: 0.0
Total Course Units: 5.0

Total Lecture Hours: 80.0
Total Laboratory Hours: 0.0
Total Laboratory Hours To Be Arranged: 0.0
Total Faculty Contact Hours: 80.0

Prerequisite: Math 104
Recommended Preparation: Math 105

Course Entry Expectations

Prior to enrolling in the course, the student should be able to:

- graph logarithmic and exponential functions;
- graph equations in polar parametric form;
- graph conic sections;
- integrate functions using variety of techniques;
- differentiate inverse trigonometric functions;
- apply L'Hospital's rule to find limits of indeterminate forms;
- evaluate improper integrals;
- model differential equations;
- solve separable differential equations;
- solve differential equations using slope fields and Euler's Method;
- work with exponential and logistic models of growth and decay;
- determine divergence or convergence of infinite series;

- differentiate and integrate power series
- find Taylor and Maclaurin series for a function;
- solve a linear system of equations using Gaussian elimination;
- solve a linear system of equations using Cramer's rule;
- perform vector arithmetic;
- find roots of polynomial functions.

Course Exit Standards

Upon successful completion of the required coursework, the student will be able to:

- perform matrix arithmetic;
- find the inverse of a matrix;
- solve a linear system of equations using matrix operations (Gaussian and Gauss-Jordan elimination);
- evaluate determinants by raw reduction and cofactor expansion;
- identify vector spaces and subspaces;
- determine if a set of vectors is linearly independent;
- find a base for and the dimension of a vector space;
- use the Gram-Schmidt process to find an orthonormal basis for an inner product space;
- find the kernel and range of a linear transformation;
- find matrix representations of linear transformations;
- find the eigenvalues and eigenvectors of a matrix;
- diagonalize a matrix;
- determine eigenvalues and eigenspaces of matrices and linear transformations;
- use quadratic forms to obtain graphs of conic sections and quadratic surfaces;
- prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.

Course Content **Total Faculty Contact Hours = 80.0**

Systems of Linear Equations and Matrices **(16 hours)**
- Introduction to systems of linear equations
- Gaussian and Gauss-Jordan elimination
- Matrix algebra, invertibility, and the transpose
- Relationship between coefficient matrix invertibility and solution to a system of linear equations and the inverse matrices
- Elementary matrices and finding the inverses of a matrix
- Results on systems of equations and invertibility
- Diagonal, triangular, and symmetric matrices

Determinants **(7 hours)**
- The determinant function
- Evaluating determinants by row reduction
- Properties of the determinant function
- Cofactor expansion; Cramer's rule

Vectors in R^n **(9 hours)**
- Introduction to vectors (Geometric)
- Norm of a vector
- Vector arithmetic
- The dot product, projections, and angle between vectors
- The cross product
- Lines and planes in 3-space

Euclidean Vector Spaces **(6 hours)**
- Euclidean n-space
- Linear transformations from R^n to R^m
- Properties of Linear transformations from R^n to R^m

General Vector Spaces **(9 hours)**
- Real vector spaces
- Subspaces
- Linear independence and dependence
- Basis and dimension
- Row space, column space and nullspace
- Rank and nullity
- Change of basis

Inner Product Spaces **(9 hours)**
- General inner products; including inner products on a real vector space
- Angle and orthogonality in inner product spaces
- Orthogonal and orthonormal bases; Gram-Schmidt process; QR-Decomposition
- Best approximation; least squares
- Orthogonal matrices; change of bases

Eigenvalues and Eigenvectors **(10 hours)**
- Eigenvalues, eigenvectors, and eigenspaces
- Diagonalization
- Orthogonal diagonalization of symmetric matrices

Linear Transformations **(10 hours)**
- General linear transformations
- Kernel and range
- Inverse linear transformations
- Matrix representations of general linear transformations
- Similarity

Applications **(4 hours)**
- Fourier series
- Quadratic forms and their applications

Methods of Instruction

The following methods of instruction may be used in this course:
- classroom lecture/discussion;
- small group work/discussion;
- computer software demonstrations.

Out of Class Assignments

The following out of class assignments may be used in this course:

- homework (e.g. problem sets related to course content);
- group assignments and projects (e.g. group project to solve a "challenging" application problem from the textbook).

Methods of Evaluation

The following methods of evaluation may be used in this course:

- quizzes
- four or more regularly scheduled exams are required;
- a comprehensive final examination is required.

Textbooks

Lay, David C. *Linear Algebra and Its Applications*. Boston: Addison-Wesley, 2012. Print.
10^{th} Textbook Reading Level. ISBN #0-321-38518-7

Student Learning Outcomes

Upon successful completion of the required coursework, the student will be able to:

- demonstrate understanding of and apply the definitions of vector space, subspace, linear independence, span, basis, dimension, and linear transformation;
- perform matrix operations, and compute determinants, eigenvalues/vectors, and inverses;
- demonstrate understanding of and apply the relationship between linear transformations, matrices and systems of equations;
- analyze, synthesize, prove, and evaluate theorems in Linear Algebra.