MATH 333 – Matrix Algebra and Complex Variables

Course Description from Bulletin: Vectors and matrices; matrix operations, transpose, rank, inverse; determinants; solution of linear systems; eigenvalues and eigenvectors. The complex plane; analytic functions; contour integrals; Laurent series expansions; singularities and residues.(3-0-3)
Enrollment: Not applicable for Math majors; Required course for EE majors; Math elective for CPE majors
Textbook(s): Tang, *Mathematic Methods for Scientists & Engineers: Complex Analysis, Determinants and Matrix (v. 1)*, Springer.

Other required material:

Prerequisites: MATH 251

Objectives:

1. Students will be able to evaluate, determine domains, and ranges (conformal mappings of regions), compute derivatives, anti-derivatives of standard complex functions.
2. Students will be able to determine harmonic conjugates, check for analyticity by Cauchy-Riemann equations.
3. Students will be able to expand analytic functions in Taylor and Laurent series.
4. Students will be able to apply Cauchy's Theorem and the Cauchy Integral Formulas to evaluate complex integrals.
5. Students will be able to find residues, zeros, and evaluate real integrals of rational and trigonometric functions by Cauchy's residue theorem.
6. Students will be able to solve systems of equations by Gauss-Jordan elimination, compute nullity and rank of linear transformations/matrices.
7. Students will be able to represent linear transformations by matrices and vice-versa.
8. Students will be able to compute eigenvalues and eigenvectors of a matrix.

Lecture schedule: Three 50 minute (or two 75 minute) lectures per week

Course Outline: Hours

1. Linear Algebra: Matrices, Vectors, Determinants — 8
   a. Basic concepts, matrix addition, scalar multiplication, matrix multiplication
   b. Inverse of a matrix
   c. Determinants
   d. Systems of linear equations
   e. Gauss elimination
   f. Eigenvalues, eigenvectors, and applications
   g. Symmetric, skew-symmetric, and orthogonal matrices
   h. Hermitian, skew-Hermitian and unitary matrices
   i. Properties of eigenvalues, diagonalization
2. Complex Numbers, Complex Analytic Functions — 12
   a. Complex numbers, complex plane, polar form
   b. Powers and roots
   c. Curves and regions in the complex plane
   d. Limit, derivative, and analytic functions
   e. Cauchy-Riemann equations
   f. Exponential functions, trigonometric functions, hyperbolic functions
   g. Logarithm, general power

3. Complex Integration 9
   a. Line integrals in the complex plane
   b. Cauchy's integral theorem
   c. Existence of indefinite integrals
   d. Cauchy's integral formula
   e. Derivatives of analytic functions
4. Power Series, Taylor Series, Laurent Series 7
   a. Review of power series
   b. Taylor series
   c. Uniform convergence
   d. Laurent series
   e. Singularities and zeroes
5. Residue Integration Method 6
   a. Residues
   b. Residue theorem
   c. Evaluation of real integrals

Assessment:	Homework	20-30%
	Quizzes/Tests	40-50%
	Final Exam	20-30%

Syllabus prepared by: Warren Edelstein and Greg Fasshauer
Date: 9/18/06, updated 11/01/12, 02/20/14