

**Michigan State University
Department of Electrical and Computer Engineering**

ECE 280: ELECTRICAL ENGINEERING ANALYSIS (Spring 2008)

Overview

Staff

Instructor (First Half of Course: 01/07/08 – 02/22/08)

Dr. L. Udpa, Professor of Electrical and Computer Engineering
Office: 2214 EB (Engineering Building)
Phone: 517-355-9261
Email: udpal@egr.msu.edu
Office hours: MW, 3:00p-4:15p and by appointment, 2214 EB

Instructor (Second Half of Course: 02/25/08 – 04/25/08)

Dr. R. Mukkamala, Associate Professor of Electrical and Computer Engineering
Office: 1219 EB
Phone: 517-353-3120
Email: rama@egr.msu.edu
Office hours: W, 2:30p-3:45p and F, 3:45p-5:00p and by appointment, 1219 EB

Grader

Name: Mr. Michael Carpenter
Email: carpe216@msu.edu
Office hours: Su, 5:00p-7:00 p, location to be announced

Lectures

MWF, 10:20a-11:10a, 1145 EB

Course Web Page

<https://angel.msu.edu>

Log on to [SS08-ECE-280-001 Electrical Engr Analysis](#).

This web page will serve as the mechanism for information exchange in this course. That is, all lecture notes, problem sets, solutions, and any other handouts will be made available through this web page. Class announcements will also be made through the web page. Thus, **the course web page should be frequently visited** throughout the semester.

Prerequisites

(MTH 234 (Multivariable Calculus)) and (ECE 201 (Circuits and Systems I) or concurrently)

Course Synopsis

This course provides an overview of the core analytical methods and complementary computing software that are utilized throughout the EE and CpE curricula, from entry level courses to advanced senior electives. More specifically, the course is divided into four parts corresponding to fundamental topics in I. Vector Calculus and Coordinate Systems; II. Complex Numbers and Variables; III. Probability, Statistics, and Random Variables; and IV. Linear Algebra. The need for these analytical methods is motivated and demonstrated through basic ECE examples involving, for example, circuits, electromagnetics, and communications. In addition, the MATLAB software package, which is widely utilized in academia and industry, is introduced for computer implementation of the analytical methods

Text

Required

Introduction to MATLAB 6-6.5 (updated 2nd edition), D. M. Etter and D. Kuncicky, Pearson Prentice Hall, 2004.

Optional (Reference)

Elements of Electromagnetics (2nd Edition), Matthew N. O. Sadiku, Saunders College Publications, Chapters 1, 2 and 3.

(for Part I of the course)

Probability and Random Processes for Electrical Engineering (2nd Edition), A. Leon-Garcia, Addison-Wesley Publishing Company, Chapters 1, 2, and 3, 1994.

(for Part III of the course)

Linear Algebra with Applications (7th Edition), S. J. Leon, Pearson Prentice Hall, Chapters 1, 2, 3, and 6, 2006.

(for Part IV of the course)

MATLAB Software Package

MATLAB is a significant part of this course and will be a part of the problems sets and exams. While MATLAB will be introduced and explained frequently in the course, it is strongly recommended that you obtain valuable initial training by reading through the information at the following URL:

<http://www.egr.msu.edu/decs/facilities/software/matlab.php>

Note that the MATLAB software package is available on all Windows and UNIX-based computers in the college and likely elsewhere on campus. A student version of the software is also available for a reasonable price. However, it is not necessary to purchase the software.

Lecture Materials

Prior to the start of each week of the semester, the lecture topics (see detailed course outline below), reading assignment, and the lecture notes for the week will be posted on the course web page. The

student may therefore skim the material to be covered prior to each lecture as well as bring the notes to class in order to facilitate the understanding of the lecture.

Problem Sets

Problem sets will generally be assigned each Monday, which will re-enforce the concepts presented during the ensuing week. **Each problem set will generally be due the next Monday in class.** A total of **15 problem sets will be assigned**; however, only **11 will be collected.** (That is, the problem sets will not be collected during each exam week.) The problem set schedule is specifically as follows:

Problem Set 1 OUT: 01/07/08, DUE: 01/14/08	Problem Set 1 Solutions OUT: 01/14/08
Problem Set 2 OUT: 01/14/08, DUE: 01/23/08	Problem Set 2 Solutions OUT: 01/23/08
Problem Set 3 OUT: 01/23/08, DUE: 01/28/08	Problem Set 3 Solutions OUT: 01/28/08
Problem Set 4 OUT: 01/28/08, DUE: NONE	Problem Set 4 Solutions OUT: 01/28/08
Problem Set 5 OUT: 02/04/08, DUE: 02/11/08	Problem Set 5 Solutions OUT: 02/11/08
Problem Set 6 OUT: 02/11/08, DUE: 02/18/08	Problem Set 6 Solutions OUT: 02/18/08
Problem Set 7 OUT: 02/18/08, DUE: NONE	Problem Set 7 Solutions OUT: 02/18/08
Problem Set 8 OUT: 02/25/08, DUE: 03/10/08	Problem Set 8 Solutions OUT: 03/10/08
Problem Set 9 OUT: 03/10/08, DUE: 03/17/08	Problem Set 9 Solutions OUT: 03/17/08
Problem Set 10 OUT: 03/17/08, DUE: 03/24/08	Problem Set 10 Solutions OUT: 03/24/08
Problem Set 11 OUT: 03/24/08, DUE: NONE	Problem Set 11 Solutions OUT: 03/24/08
Problem Set 12 OUT: 03/31/08, DUE: 04/07/08	Problem Set 12 Solutions OUT: 04/07/08
Problem Set 13 OUT: 04/07/08, DUE: 04/14/08	Problem Set 13 Solutions OUT: 04/14/08
Problem Set 14 OUT: 04/14/08, DUE: 04/21/08	Problem Set 14 Solutions OUT: 04/21/08
Problem Set 15 OUT: 04/21/08, DUE: NONE	Problem Set 15 Solutions OUT: 04/21/08

Each student may skip one of the 11 submissions without penalty or drop her/his lowest score if all 11 problem sets are submitted. While students are encouraged to work together on the problem sets, the submissions must be original (no Xerox) and in the student's own handwriting. The solutions for each problem set will be made available immediately after the problem set is due. Thus, **no late problem sets will be accepted.** For the problem sets that are not collected, the solutions will be made available with those problem sets.

Examinations

There will be **three in-class midterm exams and a final in-class exam** corresponding to the four parts of the course. (Thus, **the final exam will not be comprehensive.**) These exams will be held on the following dates:

Midterm Exam 1	February 1, 2008
Midterm Exam 2	February 22, 2008
Midterm Exam 3	March 28, 2008
Final Exam	May 2, 2008 (10:00a-12:00n)

A student will only be allowed to take a make-up midterm exam provided that there is a legitimate case of illness or personal emergency that is documented by a physician or other appropriate official. A student who finds it necessary to miss a midterm exam should contact the professor before the exam to explain the circumstances. A student who must miss the final exam should contact the professor as well as the Dean's Office according to MSU policy.

Additionally, Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Accommodations for persons with disabilities, with valid (*i.e.*, not expired) documentation from RCPD, may be requested by contacting the professor at the start of the term and/or two weeks prior to the accommodation date (exam, etc). Requests received after this date will be honored whenever possible.

Grading

Your final grade will be based on the total points earned:

10 Problem sets:	50 points (<i>i.e.</i> , 5 points for each problem set)
Midterm Exam 1:	100 points
Midterm Exam 2:	100 points
Midterm Exam 3:	100 points
Final Exam:	100 points
Total:	450 points

The final quality point grade (*e.g.*, 3.5, 4.0) for each student **will be assigned according to a curve.** More specifically, the total scores earned by all the students in the class will be rank ordered and threshold scores (*e.g.*, score above which a 4.0 is earned) will be determined, thereby establishing a final quality point score for each student. **Note that the grades indicated on the course web page are assigned by the Angel computer system and may therefore be *totally unrelated* to your final grade, which will be established by the course instructors.**

Incomplete grades will be given only in unusual cases of illness or other personal emergency, which causes the student to miss a significant amount of the course. This grade cannot be given for any other reason.

Article 2.3.3 of the Academic Freedom Report states: “The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards.” In addition, these professors adhere to the University regulations, policies, and ordinances on academic honesty and integrity, as specified in General Student Regulation 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations, all of which are available on the MSU web site (www.msu.edu). Students who violate these rules may receive a penalty grade, including, but not limited to, a failing grade on the assignment or in the course. The following conduct is specifically cited: (1) Supplying or using work or answers that are not one’s own; (2) Providing or accepting assistance with completing examinations; (3) Interfering through any means with another’s academic work; and (4) Faking data or results.

Detailed Course Outline

0. Introduction to the course and MATLAB
- I. Vector calculus and coordinate systems
 1. Vectors and Scalars
 2. Vector Operations
 - a. Dot and Cross products
 3. Coordinate Systems and Transformations,
 4. Vector Calculus
 - a. Derivatives - Del Operator, Gradient, Divergence and Curl Operations
 - b. Integrals - Line, Surface and Volume Integrals
 5. Applications - Divergence Theorem, Stokes Theorem.
- II. Complex numbers and variables
 1. Real, Imaginary and Complex Numbers
 2. Addition, Multiplication and Division of Complex Numbers
 3. Complex Conjugate, Magnitude and Phase
 4. Euler's Theorem, Representation in Polar Coordinates
 5. Functions of complex variable, Polynomials and Rational Functions
 6. Applications
 - a. Roots of Polynomials Equations, Poles and Zeroes
 - b. Linear Systems and Transfer Functions
 - c. Phasors and Instantaneous forms of signals
- III. Probability, statistics, and random variables
 - A. Probability models in electrical and computer engineering
 1. Mathematical modeling for analysis and design
 - a. Deterministic models
 - b. Probability models
 2. Interpretation of probability through relative frequency
 3. Example: probability in the design of a communication system
 - B. Basic concepts of probability theory
 1. Specifying random experiments
 - a. Sample space
 - b. Events
 - c. Set operations
 2. Axioms of probability
 - a. Discrete sample spaces
 - b. Continuous sample spaces
 3. Conditional probability and Bayes' rule
 4. Independence of events
 5. Sequential experiments and the binomial probability law
 - C. Random variables
 1. Notion of a random variable
 2. Cumulative distribution function and types of random variables
 3. Probability density function and conditionals
 4. Some important random variables
 - a. Discrete random variables

- b. Continuous random variables
- 5. Functions of random variables
- 6. Statistics of random variables
 - a. Expected value
 - b. Variance

IV. Linear algebra (with implementation in MATLAB)

- A. Linear algebra in electrical and computer engineering
- B. Matrices and systems of equations
 - 1. Systems of linear equations
 - a. Definitions
 - b. Equivalent systems
 - c. Augmented matrices
 - 2. Row echelon form
 - a. Definition
 - b. Gaussian elimination
 - c. Types of solution sets
 - d. Classes of systems
 - 3. Matrix algebra
 - a. Definitions and notation
 - b. Scalar multiplication
 - c. Matrix addition
 - d. Matrix multiplication
 - e. Algebraic rules
 - f. Identity matrix
 - g. Matrix inversion
 - h. Transpose of a matrix
 - 4. Elementary matrices
 - a. Equivalent systems
 - b. Types of elementary matrices
 - c. Nonsingularity and computing the matrix inverse
- C. The determinant
 - 1. Definition
 - 2. Properties
- D. Vector spaces
 - 1. Definition
 - 2. Subspaces
 - 3. Linear independence
 - 4. Basis and dimension
 - 5. Row space and column space
- E. Eigenvalues and eigenvectors