MATH 415 - Applied Linear Algebra

Instructors:
The professors who teach this course usually vary every semester. For the Spring 2015 and 2017 semester, Professors Bergvelt, Malkiewich, and Sapir have instructed the course. For Fall 2016, Professors Hieronymi, and Contreras Palacios instructed the course.

Prerequisites:
The only prerequisite for this course is MATH 241. This course deals entirely with linear systems, so advanced calculus is not explicitly needed. However, the geometric interpretations that are developed in Calc III are useful to visualize the concepts. Additionally, the linear transformations taught in Calculus are a great prelude to what this course is about.

When to Take It:
Although this is not a prerequisite, it is very useful to take this course before MATH 286 or ECE 210 since it will give you tools to quickly solve linear systems and provides you with an intuition of a system's behavior. Conversely, the first few weeks of this course will be a review for students who have successfully completed MATH 286.

Class Content:
The course starts with solving simple multivariate linear systems and matrices through Gaussian Elimination, and a discussion of the existence of solutions for singular and non-singular systems. These concepts then are used to develop a geometric interpretation of all the possible solutions for a given system; which leads to the definitions for vector subspaces and the dimensions of the solution. The course then reinforces the concepts by approaching solutions in a direct algebraic manner as well. The algebraic approach is used to introduce concepts as the inverse and the determinant of a matrix. Several techniques, such as Graham-Schmidt, change of bases, projections and least squares approximations are taught and used to solve different types of linear systems. The course culminates with the introduction of eigenvalues, eigenvectors and diagonalization of a matrix. Time permitting, the course will apply these concepts to Single Value Decomposition to obtain more information about the system and its solutions from a single representation of the matrix.

A detailed overview of the curriculum complete with sample lecture slides, quizzes and exams can be found at Armin Straub's course website for the Fall 2014 semester. As of the Spring 2015 semester, these slides are still used to instruct the class with minimal changes.

Work:
The workload is not very heavy for a three-hour 400 level class. More recently, the course format has shifted to quizzes in weekly discussion sections with homework assignments that are not graded or collected. In discussion, the instructor goes over the important questions from the homework that are likely to be on the quiz. The quizzes are much like those from MATH 241, where the last five minutes of the discussion section are dedicated to a simple, one or two problem quiz. The course also consists of three examinations and a cumulative final. The course grade breakdown for the Spring 2015 semester was: 10% from quizzes (with the lowest two scores dropped), 60% from three midterms (with the two highest scores counting for 26% each, the lowest counting for 8%), and 30% from the cumulative final. The breakdown for Fall 2016 was: 10% from quizzes (with the lowest two scores dropped), 60% from three midterms (20% each, and the lowest score can be replaced by a higher final exam grade), and 30% from the cumulative final.

Prior to the Fall 2014 semester, there used to be weekly homework assignments for the course that contained about 20 to 25 problems. The assignments were fairly straightforward and did not take too much time; it was safe to assume that doing all the problems will take up to 2.5 hours per assignment. There were two exams and a final for the course, and the rest of the grade (slightly less than one midterm) came from homework. The course grade breakdown for Fall 2012 was: 100 for each midterm, 200 for the final, and 80 for homework.

Life After:
The course is very useful for programming applications related to matrices and manipulating them, and therefore it provides good supplementary material for CS 225. It is not required for lower level ECE courses, but it is a prerequisite for more advanced courses such as ECE 418, ECE 470, CS 418 (Interactive Computer Graphics), CS 450 (Numerical Analysis), and ECE 513. It is a prerequisite for CS 357, an advanced computing elective for ECE and a requirement for CS.