**Math 2255 Midterm Info Sheet**

The purpose of this handout is to help you study by listing the concepts, definitions, and results you will need to know for the midterm.

**Midterm Information.** The midterm will be on Friday, Oct. 26 2006. You will **not** be allowed to bring in any notes, use the text book, or use a calculator. **Bring your STUDENT ID**.

**Material Covered.** The exam will cover all the material discussed in class about Chapters 1 and 2 of the textbook.

I have given a breakdown of what you will need to know from each section.

**Section 1.1.** Know what the following are: linear equation, system of linear equations, solution set, consistent, inconsistent, coefficient matrix, augmented matrix. Know how to solve a linear system using the elementary row operations. Know what the two fundamental questions about a linear system are.

**Section 1.2.** Know what is meant by the echelon form and reduced row echelon form of a matrix. Know the statement of Theorem 1. Understand what we mean by a pivot position and pivot column, and how to find them. Be able to use the row reduction algorithm. Know the difference between a basic variable and a free variable, and how to write a general solution to a system. Be able to use Theorem 2 to decide how many solutions a system of linear equations has.

**Section 1.3.** Know what a vector is, their geometric description, and their basic algebraic properties. Know what we mean by a vector equation and linear combination. Understand what is meant by the span of a set of vectors (Definition on page 35.)

**Section 1.4.** Know what is meant by $A\mathbf{x}$. Know how to use Theorem 3 to change solutions to $A\mathbf{x} = \mathbf{b}$ to solutions of a system of linear equations. Know the definition of what it means for columns of A to span $\mathbb{R}^m$, and how to check this condition (see Theorem 4). Know properties of Matrix-Vector Product (Theorem 5).

**Section 1.5.** Know the difference between a homogeneous and non-homogeneous solution set. Know how to determine if $A\mathbf{x} = \mathbf{0}$ has a non-trivial solution. Be able to express your solutions in parametric form (like in Example 3 and on page 54).

**Section 1.6.** Understand the two applications discussed in class: equilibrium prices and network flows. You will not be tested on balancing chemical equations.

**Section 1.7.** Know the definition of page 65. Know how to determine if the columns of a matrix $A$ are linear independent. Know what it means for one or two vectors to be linear dependent. Know Theorems 7, 8, and 9.

**Section 1.8.** Know what a transformation is, and what a linear transformation is. Note that a matrix gives rise to a linear transformation. Be able to do problems like Example 3.

**Section 1.9.** Know Theorem 10, i.e., how to use the fact that $T$ is a linear transformation to find the standard matrix for the linear transformation. Know the difference between an one-to-one and onto function, and how to determine if a linear transformation has these properties (see Theorem 12 and the discussion in class).

**Section 2.1.** Know the basic operations (addition, multiplication) for matrices. Know Theorems 1 and 2, and pay attention to the Warning on page 114. Also know what a transpose is, and some of its properties (Theorem 3).

**Section 2.2.** Know what the the inverse of a matrix is. You should know the formula for finding $A^{-1}$ when $A$ is a $2 \times 2$ matrix (see Theorem 4). As well, you need to know how to compute the inverse of a

$n \times n$ matrix. For example, you should be able to do problems like Example 7 of the section. Know also the properties of inverses (Theorem 6). You can skip the material on elementary matrices.

**Section 2.3.** Know how to use Theorem 8 (Invertible Matrix Theorem) to decide if a matrix is invertible. Also understand the relation between an invertible matrix and an invertible linear transformation (Theorem 9).

**Section 2.4.** Know what a partitioned matrix is. Know how to do operations involving partitioned matrices.

**Section 2.5.** Given a matrix $A$, you should be able to find its $LU$-factorization. As well, you should be able to use the $LU$-factorization to solve the system $A\mathbf{x} = \mathbf{b}$ (see Example 1). Skip the application in electrical engineering.

**Section 2.7.** Know only the material on 2D computer graphics (up to Example 6). Know how to compute a translation using homogeneous coordinates, as discussed in class.

Because we have not had any homework questions on Sections 2.4, 2.5, and 2.7, I will pick some of my question(s) on this material from the following list:

Section 2.4 – Questions 5-8.
Section 2.5 – Questions 7-16.
Section 2.7 – Questions 3-6.

Note that I may also have some other related questions on this material.