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

Final Exam Information. The final will be on

Thursday, Dec. 8, 2005 from 1-4PM in ATAC 1001

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 through 4, although about 50% of the material is about the material since the last midterm.

I have given a breakdown of what you will need to know from each section. For the earlier sections, please see your previous handouts (copies can be found on the web).

> **Section 4.1** Know the definition of a vector space, and know the two main examples of vector spaces, $\mathbb{R}^n$ and $\mathbb{P}_n$ (ignore Examples 3 and 5). Know the definition of a subspace, and you should know how to check whether a subset is a subspace. Also important is Theorem 1. Know how to do things like Example 11 (or Exercise 10).
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> **Section 4.2** Know the definition of a null space of a matrix and the column space of a matrix. Know how to give an explicit description of $\mathrm{Nul}(A)$ (see Example 3). Understand the differences between these two spaces (see, for example, the table on page 232). Know what the kernel and range of linear transformation are, and how they are related to $\mathrm{Nul}(A)$ and $\mathrm{Col}(A)$. Ignore Examples 8 and 9.
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> **Section 4.3** Know what it means for a collection of elements in a vector space to be linearly independent and dependent. Know the definition of a basis. Also, know the Spanning Set Theorem. Be able to find the basis of $\mathrm{Nul}(A)$ and $\mathrm{Col}(A)$.
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> **Section 4.4** Know Theorem 7, and know what is meant by the $\mathcal{B}$-coordinate of a vector. Also know about the coordinate mapping. Also important is the notion of the change-of-coordinate matrix (see page 249). You can skip the material on isomorphisms (page 251-253).
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> **Section 4.5** Theorem 9 and 10 are very important, because they provide a justification for the definition of dimension. Know the definition of dimension. Know Theorem 11 and 12, and how to compute the dimensions of $\mathrm{Nul}(A)$ and $\mathrm{Col}(A)$.
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> **Section 4.6** Know what the row space of a matrix is, and row to find a basis for $\mathrm{Row}(A)$ (see Theorem 13). Know the definition of the rank of a matrix, and know Theorem 14. You should be able to do problems like Example 3. Skip the subsection on applications to systems of equations, but know the connection between rank and the invertible matrix theorem.
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> **Section 4.7** Know what the change-of-coordinates matrix is, and know how to use Theorem 15. Be able to do problems like Example 2 and Example 3.
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> **Section 4.9** Know the definition of a probability vector, stochastic matrix, and Markov chain. Know what is meant by a steady-state vector and how to find it (see Example 5). Understand Theorem 18.

Note: Sometime before the exam, I will try to calculate your mark up to the final. I will post the results on my door and website. Please double check your marks to make sure your assignment marks were graded properly.

Good luck with your exams! –Adam