Exam II Review Sheet
MATH 289, Winter 2003

This exam will cover sections 2.1-2.3, 2.7-3.3, and 5.1-5.3 in your text. You should pay special attention to all definitions (green boxes) and theorems (blue boxes) in these sections. Below are highlighted terms and activities from each section which should be of particular interest.

1. Section 2-1, pages 107-116
   **Terms:** Matrix Multiplication, Scalar Multiplication, The Transpose of a Matrix
   **Tasks:** (a) Add, Subtract, and Multiply Matrices.
               (b) Find the transpose of a matrix.

2. Section 2-2, pages 118-125
   **Terms:** Singular and Non-Singular Matrices, Determinants, Elementary Matrices
   **Tasks:** (a) Find the inverse of a $2 \times 2$ matrix using the formula given in Theorem 4.
               (b) Use the inverse of a matrix to solve a matrix equation of the form $A\vec{x} = \vec{b}$.
               (c) Use elementary matrices to perform row operations.
               (d) Find the inverse of an $n \times n$ matrix using row reduction.

3. Section 2-3, pages 128-131
   **Terms:** Invertible Matrices and Linear Transformations, Upper/Lower Triangular Matrices
   **Tasks:** (a) State and apply the 12 equivalent conditions given in Theorem 8.
               (b) Determine if a linear transformation is invertible.

4. Section 2-8, pages 167-173
   **Terms:** Subspaces of $\mathbb{R}^n$, Column and Null Spaces of a Matrix, Basis for a Subspace of $\mathbb{R}^n$
   **Tasks:** (a) Determine if a given set of vectors is a subspace of $\mathbb{R}^n$.
               (b) Find the column space (Col $A$) and null space (Nul $A$) of a matrix $A$.
               (d) Find a basis for Col $A$ and/or Nul $A$ for a given matrix $A$.

5. Section 2-9, pages 176-180
   **Terms:** Dimension of Vector Space, Rank of a Matrix, $\mathfrak{B}$-Coordinate Vector for a Basis $\mathfrak{B}$
   **Tasks:** (a) Find the $\mathfrak{B}$-coordinate vector for a vector $\vec{x}$ relative to a basis $\mathfrak{B}$.
               (b) Find the rank of a matrix $A$, and the dimension of Nul $A$.
               (c) Relate the dimension of a matrix $A$, its rank, and the dimension of Nul $A$.

6. Section 3-1, pages 186-190
   **Terms:** Determinant, Cofactor Expansion
   **Tasks:** (a) Compute the determinant of an arbitrary $n \times n$ matrix using cofactor expansions.
               (b) Quickly find the determinant of triangular matrices.
7. Section 3-2, pages 192-198

Terms: Multiplicative Property of Determinants

Tasks: (a) Compute determinants using row operations in addition to cofactor expansion.
(b) Determine if a matrix $A$ is invertible by examining the determinant of $A$.

8. Section 3-3, pages 192-198

Terms: Cramer’s Rule, Adjugate of a Matrix

Tasks: (a) Utilize Cramer’s Rule to solve systems of linear equations.
(b) Apply the general inverse formula given in Theorem 8.
(c) Find the area of a parallelogram using the determinant.
(d) If $S$ is a parallelogram, $T$ a linear transformation, find the area of $T(S)$.

9. Section 5-1, pages 302-308

Terms: Eigenvector, Eigenvalue, Eigenspace

Tasks: (a) Determine if a given value $\lambda$ is an eigenvalue of a matrix $A$.
(b) Determine if a given vector $\vec{v}$ is an eigenvector of a matrix $A$.
(c) Find a basis for an eigenspace corresponding to a given eigenvalue.
(d) Quickly find the eigenvalues of a triangular matrix.

10. Section 5-2, pages 310-317

Terms: Characteristic Polynomial and Equation of a Matrix $A$, Multiplicity of an Eigenvalue, Similarity of Two Matrices

Tasks: (a) Find the characteristic polynomial/equation of a given matrix.
(b) Use the characteristic polynomial/equation of a matrix to find its eigenvalues.
(c) Identify the multiplicity of an eigenvalue.

11. Section 5-3, pages 319-325

Terms: Diagonalizable, Eigenvector Basis

Tasks: (a) Quickly multiply diagonal matrices.
(b) Diagonalize a matrix, or determine if it is not possible.