Exam 2 Guidelines: Material and Review Suggestions

**Date and place:** Tuesday, November 6, in class

**Additional Office Hours Before Exam:** Monday, November 5, 1:00 – 2:00

**Policies:** No MAKE-UPS.

This is a one-hour exam, but all students may stay for as long as they need to finish the exam.

**Material:**

- Chapter 1, Sections 1.8, 1.9 (Exam 1 material retested)
  - Chapter 2, Sections: 2.1, 2.2, 2.3
  - Chapter 3, Sections: 3.1, 3.2
  - Chapter 4, Sections: 4.1, 4.2, 4.3
- Homework points total = 12 points (1 point for each new section, 4 points total for the 4 group-works)
- Exam 2 total points = 88 points
- You may bring a Scientific Calculator (but not a programmable or symbolic calculator)
- You may not bring any notes or handouts
  - The Invertible Matrix Theorem (Section 2.3) will be given to you as a handout during the exam.

The exam will cover the material from the sections mentioned above, that we discussed in class and studied in the homework assignments. Suggested practice exercises: THE PRACTICE PROBLEMS at the end of each section, and exercises in the same groupings as those assigned as homework problems.

**Section by section highlights you should master:**

**Chapter 1**

**Section 1.8**

**Definitions:** Linear Transformation, Matrix Transformation

**Skills:** Use linearity of matrix vector multiplication to compute $A(u+v)$ or $A(cu)$, and the linearity of a transformation $T$ to calculate $T(cu+dv)$. Determine if a specified vector is in the range of a linear transformation, and find all the vectors $x$ satisfying $T(x) = b$.

**Section 1.9**

**Definitions:** Standard matrix of a linear transformation

**Theory:** Theorem 10 (existence of a unique standard matrix for a linear transformation, page 71)

**Skills:** Find the standard matrix of a linear transformation

**Chapter 2**

**Section 2.1**

**Definitions:** Identity matrix, zero matrix, diagonal of a matrix, triangular matrix, diagonal matrix, matrix multiplication (both ways), power of a matrix, the transpose of a matrix

**Theory:** Theorem 1, 2, 3 (Properties of operation with matrices, page 93, 97, 99)
Skills: Add, subtract and multiply matrices, multiply a matrix by a scalar, calculate powers and transposes of matrices

Section 2.2
Definitions: Inverse of a matrix, invertible matrix
Theory: Theorem 5 (uniqueness of solution of \( Ax = b \) for invertible matrix \( A \), page 104), Theorem 6 (properties of inverses, page 105), Theorem 7 (characterization of invertible matrices, page 107—you need NOT know the proof)
Skills: Algorithm for finding the inverse of a matrix

Section 2.3
Theory: Theorem 8 (The Invertible Matrix Theorem, page 112)
Skills: Use the Invertible Matrix Theorem to decide if a matrix is invertible or not, and employ the invertibility of the matrix to decide spanning and independence properties of its columns.

Chapter 3

Section 3.1
Definitions: determinant of a square matrix, cofactor, cofactor expansion
Theory: Theorem 1, 2 (cofactor expansion formula, determinants of triangular matrices, page 166, 167)
Skills: Calculate determinants

Section 3.2
Theory: Theorem 3 (effect of row operations on the determinant, p 169), Theorem 4 (characterization of invertible matrices by determinants, page 171), Theorem 5, 6 (determinants of transpose and multiplication of matrices, page 172, 173)
Skills: Use determinants to decide independence and spanning properties of vectors, use properties of determinants to simplify calculations of determinants

Chapter 4

Section 4.1
Definitions: vector space, subspace of a vector space, a subspace spanned by a set of vectors
Theorems: Theorem 1 (spanning set theorem, page 194)
Skills: determine if a set with addition and scalar multiplication is a vector space, determine if a set of vectors span \( \mathbb{R}^n \), determine if a set is a subspace

Section 4.2
Definitions: The null space of a matrix, Null \( A \); the column space of a matrix, Col \( A \) (both descriptions)
Theorems: Theorems 2, 3 (Null \( A \) and Col \( A \) are subspaces, pages 199, 201), and highlighted remark on page 202
Skills: Determine if a vector is in Null \( A \) or Col \( A \), find a non-zero vector in Null \( A \) or Col \( A \), find a spanning set for Null \( A \) or Col \( A \)

Section 4.3
Definitions: linearly independent and dependent vectors in a vector space, basis of a vector space
Theorems: Theorem 4 (characterization of linearly independent vectors, page 208), Theorem 5 (The Spanning Set Theorem, page 210), Theorem 6 (basis for Col \( A \), page 212),
Skills: determine if a set is a basis of a subspace, find a basis for Null \( A \), Col \( A \), and other subspaces.