MATH 348 - Advanced Engineering Mathematics   September 21, 2008
Exam I Review Sheet, Fall 2008

Exam will be held on September 26th in class. There will be no notecards or calculators. The exam will consist of 5 questions. The first question will test your conceptual understanding of the material. The following is a list of important topics, which you should use to guide your review for the exam.

1. **Chapter 7 - Linear Systems, Determinants, Row Reduction, Vector Spaces**

    7.1 Matrices, Vectors: Addition and Scalar Multiplication From this section the student should understand:
    - The definition of matrices, vectors and scalars.
    - The definition of matrix addition and scalar-matrix multiplication.

    From this section the student should be able to:
    - Determine the coefficient matrix associated with a linear system of equations.
    - Add and subtract matrices and vectors.
    - Multiply matrices and vectors by scalars.

    7.2 Matrix Multiplication:
    From this section the student should understand:
    - The definition of matrix multiplication.
    - The matrix vector representation of linear system of equations.

    From this section the student should be able to:
    - Multiply matrices.
    - Form the matrix vector representation of linear systems of equations.

    7.3 Gauss Elimination:
    From this section the student should understand:
    - The augmented matrix representation of a linear systems of equations.
    - The rules of row-reduction.
    - The algorithm of Gaussian elimination.

    From this section the student should be able to:
    - Write down augmented matrices associated with linear systems of equations.
    - Solve linear systems through row-reduction.
    - Determine inverse matrices through row-reduction.

    7.4 Rank of a Matrix, Vector Space:
    From this section the student should understand:
    - The definition of linear combination.
    - The definition of Column Space, Row Space and Null Space of a matrix.
    - The rank of a matrix.

    From this section the student should be able to:
    - Compute the basis and dimension of the column space, row space and null space of a matrix.
    - Compute the rank of a matrix via row-reduction.

    7.5 Solutions of Linear Systems:
    From this section the student should understand:
    - The three possible general solutions to a linear system of equations.

    From this section the student should be able to:
    - Compute the type of general solution to a linear system via row-reduction.

    7.7 Determinants.
    From this section the student should understand:

- The definition of determinants by cofactor expansion.
- The interpretation of determinant in terms of matrix inverse existence.

From this section the student should be able to:

- Compute the determinant of a matrix.

7.8 Inverse of a Matrix and Gauss-Jordan Elimination:
From this section the student should understand:

- Computation of inverses via row reduction.

From this section the student should be able to:

- Compute inverses via row reduction.

2. **Chapter 8 - Eigenvalues, Eigenvectors and Diagonalization**

8.1 Eigenvalues, Eigenvectors.
From this section the student should understand:

- The eigenvalue, eigenvector equation and the two auxiliary equations used to derive its solutions.

From this section the student should be able to:

- Compute eigenvalues and eigenvectors of square matrices.

8.4 Eigenbasis and Diagonalization
From this section the student should understand:

- The eigenbasis of a matrix.
- Geometric and Algebraic multiplicity.
- Eigenbasis and their connection to diagonalization.
- When a matrix can be orthogonally diagonalized.

From this section the student should be able to:

- Compute the eigenbasis of a matrix.
- Compute the geometric and algebraic multiplicity of an eigenvalue.
- Using the eigenbasis compute the diagonalization of a matrix.
- Using the normalized eigenbasis compute the orthogonal diagonalization of a self-adjoint matrix.