THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY | HKUST Summer School

MATH 2111 – Matrix Algebra and Applications

School:	**School of Science**
Subject Area:	**Mathematics**
Course Credit:	**3**
Instructor:	**SU Wei**
Pre-requisite/co-requisite:	**Details Here**

Notes:

- The syllabi provided here is for reference only and may be subject to changes and adjustments as determined by the course instructors.

MATH 2111 Matrix Algebra & Applications

Course Outlines – Summer 2024/25

1. Course Description

   Credit points: 3
   Pre-requisite: A passing grade in AL Pure Mathematics / AL Applied Mathematics; OR MATH 1014; OR MATH 1018; OR MATH 1020; OR MATH 1024
   Exclusion: MATH 2121, MATH 2131, MATH 2350
   Brief Info: This course covers the basic concepts and computation techniques of linear algebra that are essential for various applications in science and engineering subjects.

2. Intended Learning Outcomes

   On successful completion of this course, students are expected to be able to

No.	ILOs
1	Explain the core theories and concepts of a system of linear equations.
2	Manipulate the basic algebra and computation techniques of matrices and determinants.
3	Describe the basic terminologies that appeared in vector spaces and inner product spaces.
4	Formulate the concept and properties of eigenvalues and eigenvectors of a matrix.
5	Operate the diagonalization process and the Gram-Schmidt process, and recognize their applications

3. Assessment Scheme

   Percentages: 10% Online Webwork Exercises, 90% Final Test
   Examination duration: 3 hrs

4. Student Learning Resources

   Textbook: David C. Lay et al., *Linear Algebra and its Applications*, Fifth Edition, Pearson.

5. Teaching & Learning Activities

   Lectures: 3 hrs/week, focus on main concepts and some basic simple problems to help understand the main concepts
   Tutorials: 1 hrs/week, focus on review and presenting more complicated problems that can help students understand the materials taught in lectures; answering students' questions.
   Webwork Exercises: 3 hrs/week self-study,
   https://webwork.math.ust.hk/webwork2

6. Course Schedule (~36 lecture hours)

- **Chap 1 Systems of Linear Equations (~10 hours)**

(i) Systems of Linear Equations; (ii) Row Reduction and Echelon Forms; (iii) Vector Equations; (iv) The Matrix Equation $A\mathbf{x}=\mathbf{b}$; (v) Solution Sets of Linear Systems; (vi) Linear Independence; (vii) Linear Transformations; (viii) The Matrix of a Linear Transformation.

- **Chaps 2 & 3 Matrix Algebra and Determinants (~8 hours)**

(i) Matrix Operations; (ii) Matrix Inverse; (iii) Characterizations of Invertible Matrices; (iv) Introduction to Determinants; (v) Properties of Determinants; (vi) Cramer's Rule, Volume, and Linear Transformations

- **Chap 4 Vector Spaces (~6 hours)**

(i) Vector Spaces and Subspaces; (ii) Null Spaces, Column Spaces, and Linear Transformations; (iii) Linearly Independent Sets and Bases; (iv) Coordinate Systems; (v) Dimension of a Vector Space and Rank of a Matrix.

- **Chap 5 Eigenvalues and Eigenvectors (~4 hours)**

(i) Eigenvectors and Eigenvalues; (ii) The Characteristic Equation; (iii) Diagonalization; (iv) Applications to Dynamical Systems and Differential Equations.

- **Chap 6 Inner Product Spaces (~6 hours)**

(i) Inner Product, Length, and Orthogonality; (ii) Orthogonal Sets; (iii) Orthogonal Projections; (iv) The Gram-Schmidt Process; (v) Least-Squares Problems; (vi) Applications to Linear Models.

- **Chap 7 Symmetric Matrices and Quadratic Forms (~2 hours)**

(i) Diagonalization of Symmetric Matrices; (ii) Quadratic Forms and the Principal Axes Theorem.