

**Hong Kong Baptist University**  
**Faculty of Science**  
**Department of Mathematics**

**Title (Units): MATH 3407 Advanced Linear Algebra (3,3,0)**

**Course Aims:** This course is designed for mathematical science major students. General vector space, linear transformations, inner products, diagonal form, Jordan form, dual space and quadratic forms will be introduced. The course emphasizes on general theory of linear algebra.

**Prerequisite:** MATH2207 Linear Algebra

**Prepared by:** W.C. Shiu

**Course Intended Learning Outcomes (CILOs):**

Upon successful completion of this course, students should be able to:

<b>No. Course Intended Learning Outcomes (CILOs)</b>	
1	Recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
2	Describe the change of matrix representation of linear transformations under the change of basis
3	Visualize linear transformations as matrix form
4	Describe Jordan form for a given matrix over complex number
5	Prove most of the theorems formally
6	Articulate the importance of linear algebra and its applications in many branches of mathematics

**Teaching & Learning Activities (TLAs)**

<b>CILO</b>	<b>TLAs will include the following:</b>
1,2,3,4	<b>Lecture</b> Instructor will conduct lectures and assign assignments to consolidate understanding, analysis, and application of the theory of linear algebra. Students will consolidate the knowledge through discussion within lectures/tutorials.
3,4,5,6	<b>In-class activities</b> In addition to lectures and assignments, instructor will introduce open-ended problems in class and open-ended questions will be designed in assignments to facilitate students awareness of the importance and relevance of linear algebra concepts in other branches of mathematics
1,2,3,4,5,6	<b>Tutorial</b> Instructor will conduct weekly tutorial sessions for students to have their questions regarding the homework and lectures answered individually.

**Assessment:**

No.	Assessment Methods	Weighting	CILO Address	Remarks
1	Continuous Assessment	30%	1,2,3,4,5,6	Continuous Assignments, including homework and midterm examination, are designed to measure how well the students have learned the basic concepts and fundamental theory of linear algebra. This may involve, but not limited to, in class discussions of rigorous technical problems and their solutions.
2	Final Examination (2 Hours)	70%	1,2,3,4,5	Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be analysis and skills based to assess the student's versatility in linear algebra.

**Course Intended Learning Outcomes and Weighting:**

Content	CILO No.	Teaching (in hours)
I. Review basic knowledge of vector space	1	2
II. Vector Spaces	1,5	7
III. Linear Transformations	1,2,3,5	7
IV. Diagonal Form and Jordan Form	1,2,3,4,6	8
V. Linear and Quadratic Forms	1,2,5,6	8
VI. Inner Product Spaces	1,2,5,6	6

**Textbook**

1. W.C. Shiu, Linear Algebra, Department of Mathematics, Hong Kong Baptist University, 2016.

**References**

1. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Prentice-Hall, 1971.
2. J.T. Scheick, Linear Algebra with Applications, McGraw, 1997.

## Course Contents in Outline:

	<b>Topics</b>	<b>Hours</b>
I	Review basic knowledge of vector space A Field B Vector spaces of n-tuples C Eigenvalue problem	2
II	Vector Spaces A Basic properties B Linear dependence and independent C Bases of vector spaces D Direct sum of subspaces	7
III	Linear Transformations A Coordinates of vectors B Matrix representations C Change of bases D Householder transformations	7
IV	Diagonal Form and Jordan Form A Diagonal form B Jordan form C Algorithm for finding Jordan form	8
V	Linear and Quadratic Forms A Linear form B Dual space C Quadrate form	8
VI	Inner Product Spaces A Inner product B Induced vector norm and matrix norm C Adjoint transformation D Isometry and normal transformations	6