# UFUG2103 (L01) - Linear Algebra

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**Course title:** Linear Algebra

**Course code:** UFUG 2103

**No. of credits:** 3

**Pre-requisites:** Calculus II or Honors Calculus II

**Instructor:** Shuai JIA

**Email:** shuaijia@hkust-gz.edu.cn (mailto:shuaijia@hkust-gz.edu.cn) .

**Course hours:** Tuesday & Thursday 16:30-17:50, E1148.

**Tutorial hours:** Thursday 18:00-18:50, E1147.

**Office hours:** Friday 10:00-11:30.

**Location:** W1-507 (Please make an appointment by sending email)

**Teaching Assistants:**

Mr. Shushen Long, slong739@connect.hkust-gz.edu.cn. (mailto:slong739@connect.hkust-gz.edu.cn)

Mr. Yuxi Liu, yliu086@connect.hkust-gz.edu.cn (mailto:yliu086@connect.hkust-gz.edu.cn) .

**Course Description**

Linear algebra is central to almost all areas of mathematics and is also used in most sciences and fields of engineering. This course provides a comprehensive introduction to topics of linear algebra studies, including linear systems, vector spaces, matrices, linear mappings and matrix forms, inner products, orthogonality and Gram-Schmidt process, eigenvalues and eigenvectors, symmetric matrices and diagonalization, and determinants.

**Intended Learning Outcomes (ILOs)**

By the end of this course, students should be able to:

1. Lay solid foundations on the concepts of vector spaces, linear mappings and matrix forms.

2. Solve systems of linear equations by performing row operations and reduced row echelon forms, and verify existence and uniqueness of solutions of linear systems.
3. Understand the concept and properties of determinant and matrix operations.
4. Obtain eigenvalues and eigenvectors of a matrix or a linear transform.
5. Operate the Gram-Schmidt process and diagonalize a matrix.

**Weekly schedule & Weekly ILOs**

| Week | Topics | Weekly ILOs |
|---|---|---|
| 1 | Linear Equations I | ILO-1, ILO-2 |
| 2 | Linear Equations II | ILO-3, ILO-4 |
| 3 | Linear Equations III<br>Matrix Algebra I | ILO-2, ILO-3, ILO-4 |
| 4 | Matrix Algebra II | ILO-2, ILO-3, ILO-4 |
| 5 | Matrix Algebra III<br>Determinants I | ILO-1, ILO-2, ILO-3, ILO-4 |
| 6 | Determinants II | ILO-2, ILO-3, ILO-4 |
| 7 | Mid-term Exam | |
| 8 | Vector Spaces I | ILO-1, ILO-2, ILO-3, ILO-4, ILO-5 |
| 9 | Vector Spaces II | ILO-2, ILO-3, ILO-4, ILO-5 |
| 10 | Vector Spaces III,<br>Eigenvalues and Eigenvectors I | ILO-1, ILO-2, ILO-3, ILO-4, ILO-5 |
| 11 | Eigenvalues and Eigenvectors II, | ILO-1, ILO-2, ILO-3, ILO-4, ILO-5 |

| | | |
|---|---|---|
| | Orthogonality and Least Squares I | |
| 12 | Orthogonality and Least Squares II | ILO-1, ILO-2, ILO-3, ILO-4, ILO-5 |
| 13 | Symmetric Matrices and Quadratic Forms | ILO-1, ILO-2, ILO-3, ILO-4, ILO-5 |

***The schedule is tentative and may be subject to change.***

**Assessment and Grading**

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

**Assessments:**

| **Assessment Task** | **Contribution to Overall Course grade (%)** | **Due date** |
|---|---|---|
| Mid-Term exam | 30% | Tentatively on the $7^{th}$ week |
| Final exam | 50% | To be determined |
| Assignment & in-class quiz | 20% | |

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

**Mapping of Course ILOs to Assessment Tasks**

| **Assessed Task** | **Mapped ILOs** | **Explanation** |
|---|---|---|
| Assignments on the topic of linear equations. | ILO1, ILO2, ILO3. ILO4 | Perform row operations on matrices; identify the existence and uniqueness of solutions; represent solutions in the parametric vector form; |

| | | |
|---|---|---|
| | | understand the concept of linear transformations. |
| Assignments on the topic of matrix algebra | ILO1, ILO2, ILO3. ILO4 | Compute the product of two matrices; compute matrix inverse; identify invertible matrices; understand the concept of column space, null space, and basis of a matrix. |
| In-class quiz on the topic of determinants | ILO1, ILO2, ILO3. ILO4 | Compute the determinant of a matrix; understand the properties of determinants; application of Cramer's rule; relate determinant to volume. |
| Assignments on the topic of vector spaces | ILO1, ILO2, ILO3. ILO4, ILO5 | Identify null spaces; column spaces, and row spaces of a matrix; identify spanning sets and bases; perform coordinate transformation and change of basis. |
| Assignments on the topic of orthogonality and least squares | ILO1, ILO2, ILO3. ILO4, ILO5 | Identify orthogonal sets, orthogonal bases, and orthogonal matrices; perform orthogonal projections; application of Gram-Schmidt process; solve least squares problems. |
| Assignments on the topic of symmetric matrices and quadratic forms | ILO1, ILO2, ILO3. ILO4, ILO5 | Perform diagonalization of symmetric matrices; spectral decomposition of a symmetric matrix; compute quadratic form and conduct change of variable. |

**Grading Rubrics**

All assignment questions are sourced from the textbook. Each assignment is graded out of a total of 100 points, and the Teaching Assistant will assess them accordingly under the supervision of the

instructor.

- There will be no more than 20 questions in each assignment.
- Each question carries 5 points; full score is 100.
- If the number of questions is less than 20, say x questions, then you will get 5*(20-x) points automatically.
- For delayed submission, a penalty of 10 points will be incurred per day of delay, unless strong justifications are provided.

Answer sheets should be submitted to Canvas. Please submit in PDF format to facilitate grading.

**Final Grade Descriptors:**

| Grades | Short Description | Elaboration on subject grading description |
|---|---|---|
| A | Excellent Performance | Consistently performing at an exceptionally high standard for this level. Has a deep understanding of the knowledge and skills associated with this subject. |
| B | Good Performance | Consistently performing at a high standard for this level. Has a strong understanding of the knowledge and skills associated with this subject. |
| C | Satisfactory Performance | Woking at a good standard for this level. Gaining many of the knowledge and skills associated with this subject. |
| D | Marginal Pass | Woking at a fair standard for this level. Gaining some of the knowledge and skills associated with this subject. |
| F | Fail | Is currently struggling to master the core skills and understanding associated with this subject at this level. |

**Final grading rules:**

- A (A+ A A-): Overall Course Grade $\geq 80$ AND Ranked in the top 40%

  (A+: Overall Course Grade $\geq 95$ AND Ranked in the top 10%)
- B (B+ B B-): Overall Course Grade $\geq 70$ AND Ranked in the top 80%
- C (C+ C C-): Overall Course Grade $\geq 60$

- D: Overall Course Grade $\geq 50$
- F: Overall Course Grade $< 50$
- All subgrades except A+ (e.g. A-, B+, etc.) will be assigned based on the outcome of the overall course grades.

**Course AI Policy**

No AI is allowed.

**Communication and Feedback**

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include [specific details, e.g., strengths, areas for improvement]. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

**Resubmission Policy**

Resubmissions of assignment solutions are not allowed in general, unless strong justifications are provided. Each resubmission will be treated as a new submission. For delayed submission, a penalty of 10 points will be incurred per day of delay, unless strong justifications are provided.

**Required Texts and Materials**

Lay DC, Lay SR, McDonald JJ. Linear Algebra and Its Applications ($6^{th}$ Edition). Global Edition, Pearson.

**Academic Integrity**

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

# Course Summary:

| Date | Details | Due |
|---|---|---|

| Date | Details | Due |
| --- | --- | --- |
| **Tue Mar 17, 2026** | **In-class quiz for Chapter 3 (https://hkust-gz.instructure.com/courses/3038/assignments/22078)** | due by 5:30pm |
| **Mon Mar 30, 2026** | **Mid-term exam (https://hkust-gz.instructure.com/courses/3038/assignments/22568)** | due by 11:59pm |