MATH-UA9140L01, Linear Algebra

NYU London

Instructor Information

- Dr Mark Roberts
- Office hours: Mon 4.00 – 4.30 (G01), Thurs 9.00 – 9.30 (G05)

Course Information

- Tuesdays 9.00 – 12.00
    - Room 105
- Calculus 1 with a C or higher (or equivalent)

Course Overview and Goals

This is an introductory course on linear algebra, one of the most important and basic areas of mathematics, with many real-life applications. The course introduces students to both the theory of vector spaces and linear transformations and the techniques such as row-reduction of matrices and diagonalisation, which can be applied to problems in areas such as engineering, economics, and mathematical biology.

As well as mastering techniques, it is important that the students get to grips with the more abstract ideas of linear algebra, and learn to understand and write correct mathematical arguments. Taking an active approach to problem-solving is also important.

The class will consist of a mixture of lectures, working on problems and class discussions. Each class will correspond to two or three sections of the recommended text, which students will be expected to read. There will be weekly assignments, which are a very important part of the learning process: actively engaging with the mathematics is crucial.

Upon Completion of this Course, students will be able to:

- Understand the basic theory of vector spaces: linear independence, spanning, bases, dimension, subspaces.
- Understand the basic theory of linear transformations: matrix representation, diagonalisation, orthogonal diagonalisation
- Carry out the basic techniques of the following: row-reduction and LU decomposition to solve systems of linear equations; calculating determinants; finding eigenvalues and eigenvectors and diagonalising matrices; orthogonally diagonalising matrices.
- Apply linear algebra to solve some real-life problems.
- Be able to work with formal mathematical arguments.

Course Requirements

Grading of Assignments

The grade for this course will be determined according to these assessment components:

Assignments/ Activities	Description of Assignment	% of Final Grade	Due
Homework	Weekly homework, given out at one class and handed in at the class a week later	30%	At each class
Mid-term 1	Test on material from Chapters 1 – 3 (75 minutes)	15%	
Mid-term 2	Test on material from Chapters 4 – 5 (75 minutes)	15%	
Final exam	Exam on all material (from Chapters 1 – 7) (2 hours)	40%	

Failure to submit or fulfill any required course component results in failure of the class

Grades

Letter grades for the entire course will be assigned as follows:

Letter Grade	Percent	Description
A/A-	90 - 100%	Good understanding of ideas: ability to carry out calculations accurately: ability to produce and understand proofs and solve unseen conceptual problems.
B-/B/B+	80 - 89%	Reasonable understanding of ideas: ability to carry our calculations accurately: some ability to produce proofs.
C-/C/C+	70 - 79%	Reasonable understanding of ideas: ability to carry our calculations fairly accurately.
D/D+	65 – 69%	Some basic understanding of ideas and ability to carry our calculations with some degree of success
F	0 – 64%	Ideas not understood and inability to do calculations

Course Materials

Required Textbooks & Materials

- Linear Algebra and its applications (4th or 5th edition) by David Lay

Optional Textbooks & Materials

- You may like to look at other Linear Algebra text-books, e.g. by Strang. However, we will follow the notation and presentation of material used in the text by Lay.

Resources

- **Access your course materials**: NYU Classes (nyu.edu/its/classes)
- **Databases, journal articles, and more**: Bobst Library (library.nyu.edu)
- **NYUL Library Collection**: Senate House Library (catalogue.libraries.london.ac.uk)
- **Assistance with strengthening your writing**: NYU Writing Center (nyu.mywconline.com)
- **Obtain 24/7 technology assistance:** IT Help Desk (nyu.edu/it/servicedesk)

Course Schedule

Session/Date	Topic	Reading	Assignment Due
Session 1:	1.1 Systems of linear equations 1.2 Row reduction and echelon form 1.3 Vector equations	Text by Lay Sections: 1.1, 1.2, 1.3	CW 1
Session 2:	1.4 Matrix equations 1.5 Solutions sets of linear systems 1.7 Linear independence	Sections 1.4, 1.5, 1.7	CW2
Session 3:	1.8 Introduction to linear transformations 1.9 The matrix of a linear transformation 2.1 Matrix operations	Sections 1.8, 1.9, 1.10	CW3
Session 4:	2.2 The inverse of a matrix 2.3 Characterizations of invertible matrices 2.4 Partitioned matrices	Sections 2.2, 2.3, 2.4	CW4
Session 5:	2.5 Matrix factorizations 3.1 Introduction to determinants 3.2 Properties of determinants	Sections 2.3, 3.1, 3.2	CW5
Session 6:	4.1 Vector Spaces 4.2 Null spaces, column spaces, linear transformations 4.3 Linearly independent sets; bases	Sections 4.1, 4.2, 4.3	
Session 7:	*Mid-term 1 (on Chapters 1 – 3)* 4.4 Coordinate systems	Section 4.4	CW6
Session 8:	4.5 The dimension of a vector space 4.6 Rank 4.7 Change of basis	Sections 4.5, 4.6, 4.7	CW7

Session/Date	Topic	Reading	Assignment Due
Session 9:	Applications Revision/catch up	n/a	CW8
Session 10:	5.1 Eigenvectors and eigenvalues 5.2 The characteristic equation 5.3 Diagonalisation	Sections 5.1, 5.2, 5.3	CW 9
Session 11:	5.4 Eigenvectors and linear transformations 6.1 Inner products 6.2 Orthogonal sets	Section 5.4, 6.1, 6.2	
Session 12:	*Mid-term 2 (on Chapters 4 – 5)* 6.3 Orthogonal projections	Section 6.3	CW 10
Session 13:	6.4 Gram-Schmidt process 6.5 Least squares problem 7.1 Diagonalization of symmetric matrices	Sections 6.4, 6.5, 7.1	CW 11
Session 14:	7.2 Quadratic forms Catch-up/Revision	Section 7.2	
Final Assessment:	*Final test (on all material covered)*	n/a	

Co-Curricular Activities

Co-Curricular Activities

n/a

Classroom Etiquette

Mobiles off please

NYUL Academic Policies

Attendance and Tardiness

- Key information on NYU London's absence policy, how to report absences, and what kinds of absences can be excused can be found on our website (http://www.nyu.edu/london/academics/attendance-policy.html)

Assignments, Plagiarism, and Late Work

- You can find details on these topics and more on this section of our NYUL website (https://www.nyu.edu/london/academics/academic-policies.html) and on the Policies and Procedures section of the NYU website for students studying away at global sites (https://www.nyu.edu/academics/studying-abroad/upperclassmen-semester-academic-year-study-away/academic-resources/policies-and-procedures.html).

Classroom Conduct

Academic communities exist to facilitate the process of acquiring and exchanging knowledge and understanding, to enhance the personal and intellectual development of its members, and to advance the interests of society. Essential to this mission is that all members of the University Community are safe and free to engage in a civil process of teaching and learning through their experiences both inside and outside the classroom. Accordingly, no student should engage in any form of behaviour that interferes with the academic or educational process, compromises the personal safety or well-being of another, or disrupts the administration of University programs or services. Please refer to the NYU Student Conduct Policy for examples of disruptive behavior and guidelines for response and enforcement.

Disability Disclosure Statement

Academic accommodations are available for students with disabilities. Please contact the Moses Center for Students with Disabilities (212-998-4980 or mosescsd@nyu.edu) for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance.

Instructor Bio

Departmental Tutor and lecturer in the Mathematics Department at UCL. I currently teach first year algebra and Galois Theory to undergraduates at UCL. My research interests are in abstract algebra, in particular non-commutative ring theory.