

COURSE OUTLINE: MH5200

Course Title	Advanced Investigations in Linear Algebra I		
Course Code	MH5200		
Offered	Study Year X, Semester 1		
Course Coordinator	Xia Kelin (Asst Prof)	XIAKELIN@ntu.edu.sg	6513 7464
Pre-requisites	MH1200 OR Approval by the Division of Mathematical Sciences		
Co-requisites	MH1200		
AU	1		
Contact hours	Tutorials: 26		
Approved for delivery from	AY 2022/23 semester 2		
Last revised	10 Jan 2023, 11:43		

Course Aims

The course will introduce the advanced materials in linear algebra, including Matrices and Gaussian elimination, vector spaces, determinants, and eigenvalues and eigenvectors. The course will focus on the challenging problems in these topics and the application of these topics in sciences.

Intended Learning Outcomes

Upon successfully completing this course, you should be able to:

1. Solve complicated matrix and Gaussian elimination related problems
2. Solve complicated vector spaces problem
3. Interpret and calculate determinants, and solve some basic problems
4. Interpret and calculate eigenvalues and eigenvectors, and solve some basic problem
5. Apply knowledge of matrix, vector space, determinant, eigenvalue and eigenvector in sciences

Course Content

Matrix and Gaussian elimination problems

Vector space problems

Basic problems for determinant

Basic problems for eigenvalues and eigenvectors

Application of matrix, vector space, determinant, and eigenvalue and eigenvector in sciences

Assessment

Component	Course ILOs tested	SPMS-MAS Graduate Attributes tested	Weighting	Team / Individual	Assessment Rubrics
Continuous Assessment					
Tutorials					
Quiz 1	1, 2, 3, 5	1. a, b, c	20	individual	See Appendix for rubric
Quiz 2	1, 2, 3, 5	1. a, b, c	20	individual	See Appendix for rubric
Project	5	1. a 2. a 3. a, b 4. a	20	individual	See Appendix for rubric
Mid-semester Quiz					
Midterm Examination	1, 2, 3, 4	1. a, b, c	40	individual	See Appendix for rubric
Total			100%		

These are the relevant SPMS-MAS Graduate Attributes.

1. Competence

- a. Independently process and interpret mathematical theories and methodologies, and apply them to solve problems
- b. Formulate mathematical statements precisely using rigorous mathematical language
- c. Discover patterns by abstraction from examples

2. Creativity

- a. Critically assess the applicability of mathematical tools in the workplace

3. Communication

- a. Present mathematics ideas logically and coherently at the appropriate level for the intended audience
- b. Work in teams on complicated projects that require applications of mathematics, and communicate the results verbally and in written form

4. Civic-mindedness

- a. Develop and communicate mathematical ideas and concepts relevant in everyday life for the benefits of society

Formative Feedback

Test and quizzes: Feedback on common mistakes and the level of difficulty of the problems is given. Students will receive individual feedback on their performance in the class, quiz and test during the classes.

Group Project: Feedbacks on performance in the group project will also be given to each group of students.

Learning and Teaching Approach

Tutorials (26 hours)	This will help to develop problem solving skills, and reinforce the understanding of the concepts and notions.
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Reading and References

Gilbert Strang, Linear Algebra and Its Applications, 2006, Cengage Learning, ISBN: 9780030105678

Roger A. Horn, Charles R. Johnson, Matrix Analysis Second Edition, 2012, Cambridge, ISBN: 9780521548236

Course Policies and Student Responsibilities

Absence Due to Medical or Other Reasons

If you are sick and not able to attend a quiz or midterm, you have to submit the original Medical Certificate (or another relevant document) to the administration to obtain official leave. In this case, the missed assessment component will not be counted towards the final grade. There are no make-up quiz or make-up midterm.

Academic Integrity & Collaboration Policy

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Collaboration is encouraged for your homework because peer-to-peer learning helps you understand the subject better and working in a team trains you to better communicate with others. As part of academic integrity, crediting others for their contribution to your work promotes ethical practice.

You must write up your solutions by yourself and understand anything that you hand in. If you do collaborate, you must write on your solution sheet the names of the students you worked with. If you did not collaborate with anyone, please explicitly write, "No collaborators." Failure to do so constitutes plagiarism.

Use of materials outside the course is strongly discouraged. If you use outside source, you must reference it in your solution.

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Course Instructors

Instructor	Office Location	Phone	Email
Xia Kelin (Asst Prof)	SPMS-MAS-05-18	6513 7464	XIAKELIN@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/ Activities
1	Challenging problems for matrixes and Gaussian problems	1	Solve problems
2	Challenging problems for matrixes and Gaussian problems	1	Solve problems
3	Challenging problems for vector spaces, including linear equations, linear independence, and orthogonality.	2	Solve problems
4	Challenging problems for vector spaces, including linear equations, linear independence, and orthogonality.	2	Solve problems
5	Basic problems for determinant.	3	Solve problems
6	Basic problems for determinant.	3	Solve problems
7	Basic problems for determinant.	3	Solve problems
8	Basic problems for eigenvalue and eigenvectors	4	Solve problems
9	Basic problems for eigenvalue and eigenvectors	4	Solve problems
10	Basic problems for eigenvalue and eigenvectors	4	Solve problems
11	The application of matrix, vector space, determinant, and eigenvalue and eigenvector in Sciences.	5	Presentation (Group projects)
12	The application of matrix, vector space, determinant, and eigenvalue and eigenvector in Sciences.	5	Presentation (Group projects)
13	The application of matrix, vector space, determinant, and eigenvalue and eigenvector in Sciences.	5	Presentation (Group projects)

Appendix 1: Assessment Rubrics

Rubric for Tutorials: Quiz 1 (20%)

Point-based marking (not rubrics based)

Rubric for Tutorials: Quiz 2 (20%)

Point-based marking (not rubrics based)

Rubric for Tutorials: Project (20%)

Grading Criteria	Exceptional (18-20)	Effective (15-18)	Acceptable (12-15)	Developing (0-12)
Accuracy	The interpretation is highly accurate, concise and precise.	The interpretation is mostly accurate. Some parts can be better explained or more succinct.	The interpretation is somewhat accurate. However, it contains some inaccuracies, missing points or ideas that are not related to the interpretation.	The interpretation are mostly inaccurate.
Thoroughness	The literature review was comprehensive and rigorous. It includes several different perspectives, including a good spread of the first and latest ideas on the topic.	The literature review was mostly comprehensive and rigorous. It can improve in terms of the selection of the works relating to the topic.	The literature review was adequate. It covers some of the major works relating to the topic. References to primary source is largely missing.	The literature review was not thorough. It is based on a single source of information and/or inaccurate or unreliable secondary sources.
Presentation	Very clear and organized. It is easy to follow your train of thought	Mostly clear and organized. Some parts can have better transitions.	Somewhat clear. It requires some careful reading to understand what you are writing.	Mostly unclear and messy. It is difficult to understand what you are writing as there is no clear flow of ideas.
Question and Answer (for each individual student)	Very clear and precise answers to all problems. Explain the problems from various different perspectives logically.	Correct answers to most of the problems. Explain the problems in an organized way.	Partially-correct answers to most of the problems. Explain the some of the problems .	Unclear and messy answers. Difficult to understand.

Rubric for Mid-semester Quiz: Midterm Examination (40%)

Point-based marking (not rubrics based)