Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year	AY2022-2023
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Leonard Huang
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Course Title	Advanced Investigations in Linear Algebra II
Course Code	MH5201
Academic Units	1
Contact Hours	26
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	MH1201 OR Approval by Division of Mathematical Sciences
Co-requisites	MH1201
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

The course will introduce the advanced materials in linear algebra, in particular, determinants, eigenvalues and eigenvectors, and the deep relations between matrixes, vector spaces, determinants and eigenvalue and eigenvectors. The course will focus on the advanced and challenging problems in these topics and the application of these topics in sciences.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Solve complex problems in determinants
ILO 2	Solve complex problems in eigenvalues and eigenvectors
ILO 3	Solve complex problems in linear algebra that require a better understanding of deep relations between matrices, vector spaces, determinants and eigenvalue and eigenvectors
ILO 4	Apply advanced linear algebra knowledge in sciences
ILO 5	Solve abstract versions of problems in determinants, eigenvalues, eigenvectors, matrices and advanced linear algebra

Course Content

Different kinds of challenging problems for determinant and how to approach them. Various challenging problems for eigenvalues and eigenvectors and their solutions Challenging problems that requires a better understanding of the deep relations between matrixes, vector spaces, determinants and eigenvalue and eigenvectors. Applications of matrix, vector space, determinant, and eigenvalue and eigenvector in sciences.

Reading and References (if applicable)

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

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Challenging problems for determinant	1			solve problems
2	Challenging problems for determinant	1			solve problems
3	Challenging problems for determinant	1			solve problems
4	Challenging problems for eigenvalues and eigenvectors	2			solve problems
5	Challenging problems for eigenvalues and eigenvectors	2			solve problems
6	Challenging problems for eigenvalues and eigenvectors	2			solve problems
7	Challenging and advanced problems for linear algebra	3			solve problems
8	Challenging and advanced problems for linear algebra	3			solve problems
9	Challenging and advanced problems for linear algebra	3			solve problems

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
10	Challenging and advanced problems for linear algebra	3			solve problems
11	The application of matrix, vector space, determinant, and eigenvalue and eigenvector in sciences.		4		Presentation (Group projects)
12	The application of matrix, vector space, determinant, and eigenvalue and eigenvector in sciences.	4			Presentation (Group projects)
13	The application of matrix, vector space, determinant, and eigenvalue and eigenvector in sciences.	4			Presentation (Group projects)

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Tutorials	This will help to develop problem solving skills, and reinforce the understanding of the concepts and notions.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(Quiz 1)	1, 2, 3, 5	1. a, b, c	20		Individual	Analytic	Relational
2	Continuous Assessment (CA): Test/Quiz(Quiz 2)	1, 2, 3, 5	1. a, b, c	20		Individual	Analytic	Relational
3	Continuous Assessment (CA): Project(Project)	4, 5	1. a 2. a 3. a, b 4. a	20		Individual	Analytic	Relational
4	Continuous Assessment (CA): Test/Quiz(Midterm Examination)	1, 2, 3, 5	1. a, b, c	40		Individual	Holistic	Relational

Description of Assessment Components (if applicable)

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.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Problem Solving	Advanced
Self-Management	Advanced
Sense Making	Advanced
Transdisciplinarity	Basic

Course Policy

Policy (Academic Integrity)

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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

Policy (Absenteeism)

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.

Policy (Others, if applicable)

Diversity and inclusion policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

It is our goal to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences, and that honours your identities; including ethnicity, gender, socioeconomic status, sexual orientation, religion or ability.

To help accomplish this:

- If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety disorder or social phobia;
- If you feel like your performance in the class is being impacted by your experiences outside of class;
- If something was said in class (by anyone, including the instructor) that made you feel uncomfortable;

Please speak to your teaching team, our school pastoral officer or a peer or senior (either in-person or via email) about how we can help facilitate your learning experience.

As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can

do this by: using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.

All members of the class are expected to adhere to the NTU anti-harassment policy. if you witness something that goes against this or have any other concerns, please speak to your instructors or a faculty member.

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)