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

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	
Semester/Trimester/Others (specify approx. Start/End date)	
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
Course Author Email	clhlee@ntu.edu.sg
Course Title	Matrix Algebra and Computational Methods
Course Code	CV2019
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to:

i) Provide you with the knowledge of the fundamental principles of linear algebra and basic matrix operations;

ii) Equip you with the ability to apply computational methods to obtain solutions to problems involving: roots of equation; interpolations; differentiation and integration; simple ordinary differential equation and partial differential equations.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Solve linear system of equations using Gauss elimination method.
ILO 2	Identify solution types of Ax = b using concept of rank.
ILO 3	Apply Gauss-Jordan elimination method and Adjoint method to calculate matrix inverse.
ILO 4	Solve linear system of equations using matrix inverse and Cramer's rule.
ILO 5	Formulate simple engineering problems as eigenvalue problems.
ILO 6	Solve eigenvalue problem.
ILO 7	Apply computational methods to find the approximate roots of equations and estimate the error associated with the solutions.
ILO 8	Obtain an interpolating polynomial of the required order for a given discrete set of data pairs; and be able to assess the accuracy of the interpolated values.
ILO 9	Perform numerical differentiations and integrations and able to distinguish the order of accuracy associated with such methods.
ILO 10	Use the appropriate numerical method to find the solution of an initial value problems involving a first order and second order Ordinary Differential Equation (ODE).
ILO 11	Apply the Finite Difference Method to solve simple second order Partial Differential Equation (PDE).

Course Content

S/N	Topic
1	Introduction to matrix algebra, linear system of equations, Gauss elimination and solution types for Ax=b
2	Pivoting, Linear independence, Rank of matrix, Rank and solution type
3	Matrix inverse, Gauss-Jordan elimination, Determinant of matrix
4	Cramer's rule, Inverse by formula, Matrix norm and Matrix conditioning
5	Eigenvalues and Eigenvectors I, Eigenvalues and Eigenvectors II
6	Eigenvalues and Eigenvectors III, Further Examples
7	Revision – Matrix Algebra.
7	Introduction to Mathematical Modelling and Numerical Methods; types of error.
8	Roots of equations: Bisection and False Position Method. Newton-Raphson's Method, Secant & Modified Secant Method; error estimate.
9	Interpolation: Newton and Lagrange Polynomials; error estimate
10	Numerical Integration:Trapezoidal rule, Simpson's Rules.
11	Numerical Differentiation: forward-, centred- and backward finite divided differences.
12	Numerical Methods for solving ordinary differential equation – Euler's, Mid-point, Heun's and Runge-Kutta Methods
13	Numerical Method for solving linear Partial Differential Equations.

Reading and References (if applicable)

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra with Applications, 9th Edition", 9th Edition, John Wiley & Sons, 2005.

2. Chapra, S. C. and Canale R. P. "Numerical Methods for Engineers", 5th Edition, McGraw-Hill, 2006.

3. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction to matrix algebra, linear system of equations, Gauss elimination and solution types for Ax=b	1		In-person	Lectures & Tutorial
2	Pivoting, Linear independence, Rank of matrix, Rank and solution type	2		In-person	Lectures & Tutorial
3	Matrix inverse, Gauss-Jordan elimination, Determinant of matrix	3		In-person	Lectures & Tutorial
4	Cramer's rule, Inverse by formula, Matrix norm and Matrix conditioning	3		In-person	Lectures & Tutorial
5	Eigenvalues and Eigenvectors I, Eigenvalues and Eigenvectors II	4, 5		In-person	Lectures & Tutorial
6	Eigenvalues and Eigenvectors III, Further Examples	5		In-person	Lectures & Tutorial
7	Revision – Matrix Algebra, Overview of mathematical modelling and numerical methods.	6		In-person	Lectures & Tutorial

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
8	Roots of equations: Bisection and False Position Method. Newton-Raphson's Method, Secant & Modified Secant Method; error estimate.	7		In-person	Lectures & Tutorial
9	Interpolation: Newton and Lagrange Polynomials; error estimate	8		In-person	Lectures & Tutorial
10	Numerical Integration: Trapezoidal rule, Simpson's Rules	9		In-person	Lectures & Tutorial
11	Numerical Differentiation: forward-, centred- and backward finite divided differences.	9		In-person	Lectures & Tutorial
12	Numerical Methods for solving ordinary differential equation – Euler's, Mid-point, Heun's and Runge-Kutta Methods	10		In-person	Lectures & Tutorial

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
13	Numerical Method for solving linear Partial Differential Equations.	11		In-person	Lectures & Tutorial

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Weekly lectures to provide you with the specific knowledge and techniques to achieve the learning outcome stated above.
Tutorials	Weekly tutorials to enable you to apply the knowledge to solve structured problems. We encourage you to explore alternative approaches and techniques.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Others([final examination])	All	EAB SLOs (a), (b)	60	Team	Holistic	Relational
2	Continuous Assessment (CA): Others([quiz/test])	1,2,3,4	EAB SLOs (a), (b)	20	Team	Analytic	Multistructural
3	Continuous Assessment (CA): Others([quiz/test])	7,8,9	EAB SLOs (a), (b)	20	Team	Analytic	Multistructural

Description of Assessment Components (if applicable)

Formative Feedback

Feedback will be through the dissemination of the student's performance in quizzes as well as review of the quiz questions in class.
We encourage you to initiate an Individual consultation sessions on your particular learning needs.

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	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)

The standing university policy governing student responsibilities shall apply.
No special policy for this course.

Policy (Absenteeism)

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Policy (Others, if applicable)

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Last Updated Date: 21-11-2024 01:59:09

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