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

Course Overview

Expected Implementation in Academic Year	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Tong Ping
Course Author Email	tongping@ntu.edu.sg
Course Title	Calculus I
Course Code	MH1100
Academic Units	4
Contact Hours	51
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	
Co-requisites	
Pre-requisite to	
Mutually exclusive to	MH110S, MH1800, MH1801, MH1802, MH1805, MH1810, MH1811, CY1601
Replacement course to	
Remarks (if any)	

Course Aims

This core mathematical course aims to provide an introduction to the fundamental mathematical concepts (functions, limits, continuity, derivatives and integrals). Computation of derivatives (sum, product, and quotient formulas, chain rule, and implicit differentiation), and application of derivatives to optimization problems and related rates of change problems will also be discussed. This course lays the foundation for more advanced studies in mathematics, physics, engineering, and other related subjects.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Interpret the basic concepts in calculus, such as sets, functions, limits, continuity, derivatives and integrals.
ILO 2	Evaluate limits, rates of change, derivatives, extreme values, etc.
ILO 3	Prove the limit and continuity of a function at a certain point or infinity.
ILO 4	Use the basic calculus techniques, such as chain rules, curve sketching, and optimization.
ILO 5	Use mean value theorem to prove a result.
ILO 6	Select the right mathematical concepts and models for real problems, such as those related to velocity and curve properties.
ILO 7	Apply the calculus techniques to solve related rate and optimization problems.

Course Content

Sets and Functions
Introduction to the concept of limit, limit laws, squeeze theorem
Precise definition of limit: the epsilon-delta definition
Limits: Advanced topics such as the uniqueness of the limit, one-sided limits, limits to positive or negative infinity.
Introduction to the concept of continuity, continuous functions and limits, intermediate value theorem
The definition of derivative, continuous and differentiable properties of a function
Differentiation rules, the calculus of the trigonometric functions
Chain rule
The theory of extreme values, mean value theorem
Limits at infinity, curve sketching, Optimization problems
Newton's method
Antiderivatives
Review

Reading and References (if applicable)

Stewart, James. *Calculus*. 8th ed., Cengage Learning, 2015. ISBN-10: 1285740629 / ISBN-13: 978-1285740621

Stewart, James, Daniel K. Clegg, and Saleem Watson. *Calculus*. 9th ed., Cengage Learning, 2020. ISBN 10: 1337624187 / ISBN 13: 9781337624183

NOTE: The above listing comprises the foundational readings for the course and more up-todate relevant readings will be provided when they are available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Sets and Functions	1		In-person	
2	Introduction to the concept of limit, limit laws, squeeze theorem	1, 2		In-person	
3	Precise definition of limit: the epsilon-delta definition	1, 2, 3		In-person	
4	Limits: Advanced topics such as the uniqueness of the limit, one-sided limits, limits to positive or negative infinity.	1, 2, 3		In-person	
5	Introduction to the concept of continuity, continuous functions and limits, intermediate value theorem	1, 2, 3		In-person	
6	The definition of derivative, continuous and differentiable properties of a function	1, 2		In-person	

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
7	Differentiation rules, the calculus of the trigonometric functions	1, 2		In-person	
8	Chain rule, Midterm Test	4		In-person	
9	The theory of extreme values, mean value theorem	5		In-person	
10	Limits at infinity, curve sketching, Optimization problems	6, 7		In-person	
11	Newton's method	6		In-person	
12	Antiderivatives	1		In-person	
13	Review			In-person	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures (39 hours)	Derivation and demonstration: Explain the motivation behind mathematical concepts. Present systematic ways to solve problems related to the concepts developed. Derive important formulas and theorem that are fundamental in the study of Calculus. Problem solving: Develop competence in solving a variety of problems related to rates of change and optimization
Tutorials (12 hours)	Concept Reinforcement: Clarify and deepen understanding of key mathematical concepts introduced in lectures through guided examples and additional derivations where necessary. Problem-Solving Practice: Strengthen competence by working through a variety of problems involving rates of change, optimization, and related applications under the guidance of the instructor. Peer Instruction: Foster communication and presentation skills by collaborating with peers, discussing solution strategies, and presenting solutions to the class, thereby consolidating understanding through active participation.

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()	1, 2, 3		10	Three in-class quizzes will be conducted during Weeks 1–7. The specific dates will not be announced in advance. Each quiz carries a weight of 5%. Students are required to attempt any two quizzes. If all three quizzes are attempted, the two highest scores will be counted.	Individual	Analytic	Relational
2	Continuous Assessment (CA): Test/Quiz()	1, 2, 3, 4, 5, 6		10	Three in-class quizzes will be conducted during Weeks 8–13. The specific dates will not be announced in advance. Each quiz carries a weight of 5%. Students are required to attempt any two quizzes. If all three quizzes are attempted, the two highest scores will be counted.	Individual	Analytic	Relational
3	Continuous Assessment (CA): Test/Quiz()	1, 2, 3, 4		20	Mid-semester Test: Short Answer Questions	Individual	Analytic	Extended Abstract

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
4	Summative Assessment (EXAM): Final exam()	1, 2, 3, 4, 5, 6 , 7		60	Examination - Short Answer Questions	Individual	Analytic	Extended Abstract

Description of Assessment Components (if applicable)

Formative Feedback

Components 1 and 2: Formative feedback written beside your solutions to quiz questions will be returned to you.

Component 3: Feedback on common mistakes and your midterm test scripts will be provided.

Component 4: An examiner's report will be issued to give formative feedback on common mistakes.

You will also receive formative feedback for all learning outcomes (including LO 7 tested in the final exam) during weekly tutorial classes from Week 2-Week 13.

NTU Graduate Attributes/Competency Mapping

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

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

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)

Students are expected to attend classes regularly, participate actively, and take responsibility for keeping up with all course materials and announcements. Assessments will include quizzes, tests, and examinations, with grading based on a combination of these components. Academic integrity must be upheld at all times, and any form of misconduct will be subject to university regulations. Students are encouraged to seek support through office hours, tutorials, and learning resources whenever needed, and are expected to maintain professionalism and respect in all course-related activities.

Policy (Absenteeism)

Absence due to medical or other reasons

If you are sick and unable to attend a midterm test or missed the deadlines for your assignments, you must:

1. Send an email to the instructor regarding the absence.
2. Submit the original Medical Certificate* to an administrator.

*The Medical Certificate mentioned above should be issued in Singapore by a medical practitioner registered with the Singapore Medical Association.

In this case, the total course marks would be rescaled to a base of 100%.

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.

Collaboration Policy

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 in your profession. 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.

Appendix 1: Assessment Rubrics

Rubric for Lectures: (Weeks 1-7) In-Class Quizzes (10%)

Point-based marking (not rubrics based)

Rubric for Lectures: (Weeks 8-13) In-Class Quizzes (10%)

Point-based marking (not rubrics based)

Rubric for Mid-semester Quiz: Short Answer Questions (20%)

Point-based marking (not rubrics based)

Rubric for Examination: Short Answer Questions (60%)

Point-based marking (not rubrics based)