# COURSE OUTLINE: MH1100-MH110S

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|---|---|---|---|
| Course Title | **Calculus I** | | |
| Course Code | **MH1100-MH110S** | | |
| Offered | Study Year 1, Semester 1 | | |
| Course Coordinators | Tong Ping (Asst Prof) | tongping@ntu.edu.sg | 6513 7457 |
| | Xia Kelin (Asst Prof) | XIAKELIN@ntu.edu.sg | 6513 7464 |
| Pre-requisites | None | | |
| Mutually exclusive | MH110S, MH1800, MH1801, MH1802, MH1805, MH1810, MH1811, CY1601 | | |
| AU | 4 | | |
| Contact hours | Lectures: 39, Tutorials: 12 | | |
| Approved for delivery from | AY 2020/21 semester 2 | | |
| Last revised | 25 Nov 2020, 10:49 | | |

## 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.

## Intended Learning Outcomes

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

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

## Course Content

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

## Assessment

| Component | Course ILOs tested | SPMS-MAS Graduate Attributes tested | Weighting | Team / Individual | Assessment Rubrics |
|---|---|---|---|---|---|
| **Continuous Assessment** | | | | | |
| **Lectures** | | | | | |
| Assignment 1 | 1, 2, 3 | **1.** a<br>**5.** a | 10 | individual | See Appendix for rubric |
| Assignment 2 | 1, 2, 3, 4, 5, 6 | **1.** a<br>**5.** a | 10 | individual | See Appendix for rubric |
| **Mid-semester Quiz** | | | | | |
| Short Answer Questions | 1, 2, 3, 4 | **1.** a | 20 | individual | See Appendix for rubric |
| **Examination (2 hours)** | | | | | |
| Short Answer Questions | 1, 2, 3, 4, 5, 6, 7 | **1.** a | 60 | 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

**5. Character**

a. Act in socially responsible and ethical ways in line with the societal expectations of a mathematics professional, particularly in relation to analysis of data, computer security, numerical computations and algorithms

## Formative Feedback

Components 2 and 4: Formative feedback written beside your homework solution will be returned to you.

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

Component 1: 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.

## Learning and Teaching Approach

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|---|---|
| **Lectures** (39 hours) | Derivation and demonstration:<br>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.<br><br>Problem solving:<br>Develop competence in solving a variety of problems related to rates of change and optimization. |
| **Tutorials** (12 hours) | Derivation and demonstration:<br>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.<br><br>Problem solving:<br>Develop competence in solving a variety of problems related to rates of change and optimization.<br><br>Peer Instruction:<br>Develop communication and presentation skills and deepen understanding. You have the opportunity to work with peers and present your solutions to the class. |

## Reading and References

James Stewart, Calculus (8th edition) ISBN: 978-1285740621

## Course Policies and Student Responsibilities

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.

The missed component will not be counted towards the final grade.

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.

## 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. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

## Course Instructors

| Instructor | Office Location | Phone | Email |
|---|---|---|---|
| Xia Kelin (Asst Prof) | SPMS-MAS-05-18 | 6513 7464 | XIAKELIN@ntu.edu.sg |
| Tong Ping (Asst Prof) | SPMS-MAS-04-17 | 6513 7457 | tongping@ntu.edu.sg |

## Planned Weekly Schedule

| Week | Topic | Course ILO | Readings/ Activities |
|---|---|---|---|
| 1 | Functions | 1 | |
| 2 | Introduction to the concept of limit, limit laws, squeeze theorem | 1, 2 | |
| 3 | Precise definition of limit: the epsilon-delta definition | 1, 2, 3 | |
| 4 | Limits: Advanced topics such as the uniqueness of the limit, one-sided limits, limits to positive or negative infinity. | 1, 2, 3 | |
| 5 | Introduction to the concept of continuity, continuous functions and limits, intermediate value theorem | 1, 2, 3 | CA 1: Homework 1 |
| 6 | The definition of derivative, continuous and differentiable properties of a function | 1, 2 | |
| 7 | Differentiation rules, the calculus of the trigonometric functions | 1, 2 | |
| 8 | Chain rule | 4 | CA 2: Midterm Test |
| 9 | The theory of extreme values, mean value theorem | 5 | |
| 10 | Limits at infinity, curve sketching, Optimization problems | 6, 7 | |
| 11 | Newton’s method | 6 | CA 3: Homework 2 |
| 12 | Antiderivatives | 1 | |
| 13 | Review | | |

## Appendix 1: Assessment Rubrics

### Rubric for Lectures: Assignment 1 (10%)
Point-based marking (not rubrics based)

### Rubric for Lectures: Assignment 2 (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)