Math 2023 (lecture sessions 1 ,2 ,3) Multivariable Calculus

Course Outline – Fall Semester 2025

1. Course Instructor

Name: Dr. Hon-Ming HO

Contact Details: Room 3419, Phone 34693032, e-mail: mastanho@ust.hk

Office Hour: Tuesday from 12:00 pm to 2:00 pm

2. Teaching Assistant

Name: KONG, Hoi-Sang

Contact Details: Room 3010, e-mail: mahsk@ust.hk

Name: XIE, Qing

Contact Details: Room 3012, e-mail: maqxie@ust.hk

3. Meeting Time and Venue

Lectures: L1: Monday, Wednesday, Friday 1:30 pm- 2:20 pm in 2465

Tutorial: T1a: Wednesday 18:00-18:50 Room 6602

Tutorial: T1b: Wednesday 12:30-13:20 Room 6602

Tutorial: T1c: Wednesday 09:30-10:20 Room LG3008

Lectures: L2: Monday, Wednesday, Friday 9:30 am -10:20 am in 2502

Tutorial: T2a: Tuesday 18:00-18:50 in CYTG009A

Tutorial: T2b: Monday 12:00-12:50 in LSK1014

Tutorial: T2c: Wednesday 18:00-18:50 in Room 2304

Lectures: L3: Monday, Wednesday, Friday 12:00 pm-12:50 pm in classroom 2502

Tutorial: T3a: Monday 14:00-14:50 in Room 4579

Tutorial: T3b: Wednesday 14:00-14:50 in CYTG009B

Tutorial: T3c: Thursday 18:00-18:50 in Room 4502

4. Course Description

- Credit Points: 4 units
- Pre-requisite: A passing grade in Hong Kong AL Pure Mathematics / AL Applied Mathematics; OR MATH1014; OR MATH1020; OR MATH1024
- Exclusion: MATH2011
- Brief Information/Synopsis:
  Topics include Differentiation in several variables, with applications in approximation, maximum and minimum and geometry, Lagrange multipliers, integration in several variables, vector analysis, Green's theorem, Stoke's theorem, divergence theorem, change of variables.

5. Intended Learning Outcomes

Upon successful completion of this course, students should be able to do:

No.	ILOs
1	Develop an understanding of the core ideas and concepts and principles of limits, differentiation, and integration of functions in multiple variables, vector analysis, Green's Theorem, Divergence Theorem and Stoke's Theorem.
2	Recognize the power of abstraction and generalization, carry out mathematical work with independent judgement,
3	Apply rigorous, analytical and numeric approach to analyze and solve problems using concepts of multivariable calculus,
4	Communicate problem solutions using correct mathematical terminology and good English.

6. Assessment Scheme and Grading

a) This course will be assessed using criterion-referencing, and grades will NOT be assigned using a curve.

b) Examination duration: 120 minutes for mid-term exam (closed book exam, no calculators), 2.5 hours for the final examination (closed book exam, no calculators).

c) Percentage of coursework, examination:

Assessment task	Contribution to Overall Course grade (%)	Due Date
Online homework	16%	3rd, 6th, 9th, 12th, 13th academic weeks
Mid-term Examination	28%	8th November (Saturday) 7 pm to 9 pm
Final Examination	56%	Fall Term Examination Period

Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of course ILOs to the Assessment Tasks

Assessed Task	Mapped Course ILOs	Explanation
Online homework assignment	ILO1, ILO2, ILO3, ILO4	This task assesses students' ability to explain and apply Multivariable Calculus concepts (ILO 1), evaluate their implications (ILO 2) and (ILO 3) and catch up with the lecture materials to handle different multivariable calculus problems (ILO 4).]
Mid-term examination	ILO1, ILO2, ILO3, ILO4	This task assesses students' ability to explain and apply Multivariable Calculus concepts from lecture notes 1 to lecture notes 20 (Lagrange multipliers) (ILO 1), evaluate their implications (ILO 2) and (ILO 3), present problem solutions using correct mathematical terminology and good English (ILO 4).
Final examination	ILO1, ILO2, ILO3, ILO4	This task assesses students' ability to explain and apply Multivariable Calculus concepts from lecture notes 1 to lecture notes 37 (ILO 1), evaluate their implications (ILO 2) and (ILO 3), present problem solutions using correct mathematical terminology and good English (ILO 4).

d) Grade Descriptors:

Grades	Short Descriptions	Elaboration on subject grading description
A+, A, A-	Excellent Performance	The student has mastered ***all concepts and techniques*** of multivariable calculus taught in this course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of higher-level mathematics courses, for instance, Partial Differential Equations, Differential Geometry, Calculus on Manifolds.
B+, B, B-	Good Performance	The student has mastered most computational techniques of multivariable calculus taught in this course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.
C+, C, C-	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic computational techniques of the subject, yet some concepts were not clearly understood.
D	Marginal Pass	The student is only able to recall some fragments of topics and is able to complete some of the easiest computations.

F	Fail	The student does not have sufficient understanding of even some fragments of topics, and is not even able to complete some of the easiest computations.

7. Academic Integrity

- Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity -HKUST-Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.
- Make-up Exam Policy: The make-up mid-term exam will only be considered with at least a 6-hour notice and with proper supporting documents before the regular exam session. The make-up final examination will follow the make-up exam policy set by ARO.
- Course AI policy: The use of Generative AI is permitted to use when doing homework. Students should be critical of the response generated by AI and do not blindly copy the generated responses to your homework. Students are particularly cautioned about the potential inaccuracies and fallacies that may arise from AI-generated answers. Additionally, our final examination will be closed book (no calculators), meaning that AI tools and resources will not be available during exams. This policy is in place to prevent overreliance on such tools and to ensure that assessments accurately reflect each student's individual understanding and capabilities.

8. Student Learning Resources

- *Lecture notes*: Lecture notes will be uploaded in CANVAS before every lecture.
- ***Textbook*: Calculus Early Transcendentals by James Stewart, 9th edition, BROOKS/COLE CENGAGE Learning**
- *Math Support Center:* Learning support provided by Mathematics Department (http://www.math.ust.hk/~support)

9. Teaching and Learning Activities

Scheduled activities: 3 hours (lecture) + 1 hour (tutorial).

Lecture will focus on illustrating the concepts of the course content, while tutorials will focus on examples and problem skills.

10. Course Schedule

Week	Key Topics
1	Three-Dimensional space (section 12.1), Quadric Surfaces (section 12.6) , Vectors in the plane (section 12.2) , Vectors in three dimensions (section 12.2) ,Dot products (section 12.3)
2	Cross products (section 12.4), Lines and planes in 3-space (section 12.5)
3	Calculus I of vector-valued functions, Motion in space, Calculus II of vector-valued functions, Length of curves (section 13.1, 13.2, 13.3)
4	Functions of several variables, level curves, limits and continuity of functions of several variables, partial differentiation (section 14.1, 14.2, 14.3)
5	Differentiability of functions of several variables, Chain rules, directional derivatives and gradient vectors (section 14.5, 14.6)
6	Gradient vectors, Tangent planes and linear approximations, Maximum and Minimum values (section 14.4, 14.7)
7	Extreme values, Lagrange multipliers (section 14.7, 14.8)
8	Double integration on rectangular regions, double integration on general regions, polar coordinate system (section 15.1, 15.2, 15.3)

9	Double integrals in polar coordinate, surface area, triple integrals in rectangular coordinate system (section 15.4, 15.6, 15.7)
10	Triple integrals in cylindrical coordinate system (section 15.8), line integrals, vector fields and line integrals in vector fields (section 16.1, 16.2)
11	Flux of a vector field, path independence, potential functions and conservative vector fields and Green's theorem in the plane (section 16.3, 16.4, 16.5, 16.6)
12	Surface integrals, flux of a vector field across a surface (section 16.7)
13	Divergence theorem and Stoke's theorem (section 16.8, 16.9)