

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

Course Outline – Fall Semester 2024

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: maqie@ust.hk

3. Meeting Time and Venue

Lectures: L1: Monday, Wednesday, Friday 9:30 am- 10:20 am in CYTG010

Tutorial: T1a: Thursday 11:00 - 11:50 LSK1027

Tutorial: T1b: Monday 13:00 - 13:50 Room 6602

Tutorial: T1c: Friday 13:30 - 14:20 Room LSK1033

Tutorial: T1d: Wednesday 17:00 - 17:50 Room 2504

Lectures: L2: Monday, Wednesday, Friday 12:00 pm -12:50 pm in CYTG010

Tutorial: T2a: Wednesday 09:30 - 10:20 Room 2304

Tutorial: T2b: Wednesday 15:00 - 15:50 Room 1410

Tutorial: T2c: Monday 09:30 - 10:20 Room 6580

Tutorial: T2d: Tuesday 17:30 - 18:20 Room 1409

Lectures: L3: Monday, Wednesday, Friday 3:00 pm-3:50 pm in classroom 6591

Tutorial: T3a: Monday 18:00-18:50 Room 1527

Tutorial: T3b: Thursday 18:00 - 18:50 Room 1527

4. Course Description

- Credit Points: 3 units
- Pre-requisite: A passing grade in 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.
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 (nor a surface).**
- 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	Assessing Course ILOs
15% by online homework assignment	1, 2, 3, 4
30% by mid-term examination	1, 2, 3, 4
55% by final examination	1, 2, 3, 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.
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.

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)