MATH 2011 Introduction to Multivariable Calculus

Course Outline – Fall Term 2025/2026

1. Instructor: Math2011 (L2) by *Professor* ***Tiezheng QIAN***

Email: maqian@ust.hk **Office**: Room 3437

Office hours: Appointments via email

2. Lecture/Tutorial Hours and Venues:

QIAN, Tiezheng/maqian	L2	Tue/Thu	15:00-16:20	LTA
LI, Yakun/ylinv	T2A	Wed	11:30-12:20	1527
LI, Yakun/ylinv	T2B	Wed	13:00-13:50	6555
ZHANG, Wenlin/wzhangdh	T2C	Thu	18:00-18:50	4580
ZHANG, Wenlin/wzhangdh	T2D	Mon	18:00-18:50	CYTG009B

3. COURSE DESCRIPTION

Credits: 3

Parametric and Polar Curves, Vectors and Vector-Valued Functions, Functions of Several Variables, Multiple Integration, Vector Calculus.

Exclusion: MATH 2010, MATH 2021, MATH 2023

Pre-requisite: A passing grade in AL Pure Mathematics / AL Applied Mathematics; OR MATH 1014; OR MATH 1018; OR MATH 1020; OR MATH 1024 (*for appropriate knowledge in one-variable calculus*)

4. INTENDED LEARNING OUTCOMES (ILOs)

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

1	Understand the basic *concepts* and know the basic *techniques* of differential and integral calculus of functions of several variables;
2	Apply the theory to calculate the gradients, directional derivatives, arc length of curves, area of surfaces, and volume of solids;
3	Solve problems involving maxima and minima, line integral and surface integral, and vector calculus;
4	Develop mathematical maturity to undertake higher level studies in mathematics and related fields.

5. ASSESSMENT SCHEME (to be updated)

10% Homework: WeBWorK. Course ILOs: 1, 2, 3, 4

30% Midterm Exam: November 1, 2025. Course ILOs: 1, 2, 3, 4

60% Final Exam. Course ILOs: 1, 2, 3, 4

Final exam is comprehensive, i.e., all the materials taught in the whole semester will be tested, including those already tested in the midterm exam. But **focus** will be on those topics not covered in the midterm.

Closed-book exams: No notes and no calculators. More information will be given prior to the exams.

5.1 Letter Grades

Students should aim at getting a **course total** of 85% or above for A-/A/A+, and about 65% or above for B-/B/B+. (Here the numbers are illustrative and subject to change from year to year.)

5.2 Grade Descriptors

Grade A — *Excellent Performance*: The student has mastered almost all concepts and techniques of the topics covered in the course and has acquired workable knowledge for further and deeper studies.

Grade B — *Good Performance*: The student has mastered a good part of concepts and techniques of the topics covered in the course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.

Grade C — *Satisfactory Performance*: The student meets the minimum expectation of the instructor by acquiring some basic computational techniques of the subject, yet some concepts were not clearly understood.

Grade D — *Marginal Pass*: The student can only recall some fragmented topics and complete some easiest computations.

Grade F — *Fail*: The student cannot even recall some fragmented topics and complete some easiest computations.

6. Student Learning Resources

Textbook: Calculus – James Stewart. BROOKS/COLE

Reference: *Calculus for Scientists and Engineers: Early Transcendentals* – Briggs, Cochran and Gillett. Pearson New International Edition. There are also plenty of resources on the internet.

7. Teaching and learning Activities

Scheduled activities: 4 hours (Lecture for 3 hours & Tutorial for 1 hour) per week

8. TEACHING SCHEDULE for 25 classes in total

Topic 1. **Parametric and Polar Curves:** ***Class 1 to 3 (3 classes)***

1. Parametric equations
2. Polar coordinates
3. Calculus in polar coordinates

Topic 2. **Vectors and Vector-Valued Functions:** ***Class 4 to 9 (6 classes)***

1. Vectors in the plane
2. Vectors in three dimensions
3. Dot products
4. Cross products
5. Lines and curves in space
6. Calculus of vector-valued functions
7. Motion in space
8. Length of curves
9. Curvature and normal vectors

Topic 3. **Functions of Several Variables:** ***Class 10 to 17 (8 classes)***

1. Planes and surfaces
2. Graphs and level curves
3. Limits and continuity
4. Partial derivatives
5. The chain rule
6. Directional derivatives and the gradient
7. Tangent planes and linear approximation
8. Maximum/minimum problems

Topic 4. **Multiple Integration:** ***Class 18 to 21 (4 classes)***

1. Double integrals over rectangular regions
2. Double integrals over general regions
3. Double integrals in polar coordinates
4. Triple integrals

Topic 5. **Vector Calculus:** ***Class 22 to 25 (4 classes)***

1. Vector fields
2. Line integrals
3. Conservative vector fields
4. Green's theorem

9. Course AI Policy

Students are allowed to consult any person (including the instructor, TA, classmates, friends outside HKUST) in any homework for ideas and hints but are required to write up the solutions by themselves. You are required to list the people and references you have consulted in every homework assignment. The use of ChatGPT or other generative AI is allowed, and they are regarded as "people" you have consulted and therefore must be listed in your homework. However, please be warned that at the current stage of development of AI, the response to problems in advanced courses is not quite reliable. Students should be critical of the response generated by AI and do not blindly copy the AI-generated responses to your homework.

10. 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***.