

MATH 2011 Introduction to Multivariable Calculus

Course Outline – Spring 2026

1. Instructors:

(L1, L2) **Dr. KU Yin Bon**

Email: maybku@ust.hk

Office: Room 3419 (near Lifts 17/18)

Office hours: TBA

(L3) **Dr. YAO Jing**

Email: majyao@ust.hk

Office: Room 3450 (near Lifts 25/26)

Office hours: Appointments via email

2. Lecture/Tutorial Hours and Venues:

Instructor / Email	Section	Date/Time		Venue
KU, Yin Bon (Albert)/maybku	L1	Mon	13:30-14:50	LTF
		Fri	09:00-10:20	
	L2	Mon/Wed	10:30-11:50	Rm 5403
SUN, Weixiao/wsunas	T1A	Thu	10:30-11:20	LSK1032
WEI, Xuchen/xweiaiv	T1B	Wed	09:30-10:20	LG426(LIB)
HAN, Shi/shanav	T1C	Mon	18:00-18:50	LSK1014
HOU, Jiantong/jhouap	T2A	Thu	17:00-17:50	LSK1027
WU, Jiacheng/jwudt	T2B	Tue	18:00-18:50	Rm 1527
WANG, Haoyu/hwanghi	T2C	Thu	09:30-10:20	Rm 2463
YAO, Jing/majyao	L3	Tue/Thu	13:30-14:50	Rm 2464
WANG, Hongrui/hwangfb	T3A	Wed	12:00-12:50	Rm 2306
YAN, Bokai/byanac	T3B	Mon	17:30-18:20	Rm 1410
CHU, He/hchuaf	T3C	Fri	10:30-11:20	Rm 5402

3. COURSE DESCRIPTION

Credits: 3

Vectors and Curves, 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 <i>concepts</i> and know the basic <i>techniques</i> 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 vector calculus;
4	Develop mathematical maturity to undertake higher level studies in mathematics and related fields.

5. ASSESSMENT SCHEME

12% WeBWorK assignments, Course ILOs: 1, 2, 3, 4,

28% Midterm exam. One-hour exam, arrangement to be announced, Course ILOs: 1, 2

60% Final Exam. Two-hour exam, to be arranged by ARO, Course ILOs: 1, 2, 3, 4

Final exam is comprehensive, i.e., all the materials taught in the whole semester will be tested.

All exams are open book (i.e. you can bring any printed materials such as lecture notes, homework solutions and so on but no digital medium is allowed). Also, non-graphical calculators are permitted in the exams. More information will be given prior to the exams. There is no make-up for midterm exam. If you are absent from the midterm due to sickness with a valid proof, the weight of your scores will be shifted to the final i.e. 88% final, 0% midterm. Invalid reasons for absence will make your midterm 0 mark.

Letter Grades will be assigned based on the total marks achieved in the above four assessments.

Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of multivariable calculus taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of analysis, differential and partial differential equations, Riemannian geometry, optimization and related fields.
B	Good Performance	The student has mastered most computational techniques of multivariable calculus taught in the course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.
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.

6. Student Learning Resources

Main reference: Lecture slides prepared by instructors.

Study Reference:

- *Vector Calculus*, by Suan J. Colley;
- *Calculus for Scientists and Engineers: Early Transcendentals* – Briggs, Cochran and Gillett. Pearson New International Edition.
- *Calculus* – James Stewart. BROOKS/COLE

All learning materials will be posted on canvas.

7. Teaching and learning Activities

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

8. Tentative TEACHING SCHEDULE for 25 classes in total

Topic 1. **Vectors and Curves:** Class 1-6

1. Vectors in the plane and three-dimensional space
2. Dot products and cross products
3. Lines and planes in space
4. Parametric curves
5. Calculus of vector-valued functions
6. Motion in space
7. Length and arclength parameterization of curves
8. Curvature of curves

Topic 2. **Functions of Several Variables:** Class 7–12

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

Topic 3. **Multiple Integration:** Class 13-20

1. Double integrals over rectangular regions
2. Double integrals over general regions
3. Polar coordinates
4. Double integrals in polar coordinates
5. Triple integrals
6. Cylindrical and spherical coordinates
7. Triple integrals in cylindrical and spherical coordinates.

Topic 4. **Vector Calculus:** Class 21 – 25

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 persons and references you have consulted in every homework. The use of ChatGPT or other generative AI is allowed, and they are regarded as “persons” 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 — may not be reliable. Students should be critical of the response generated by AI and do not blindly copy the 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. Please refer to Academic Integrity | HKUST – Academic Registry for the University’s definition of plagiarism and ways to avoid cheating and plagiarism.