

MATH 2011 Introduction to Multivariable Calculus

Course Outline – Spring Term 2023/2024

1. Instructor: (L1) Dr. Jing YAO

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	Quota
YAO, Jing / majyao	L1	Wed/Fri	13:30 - 14:50	4620	120
ZHANG, Jiawang / jzhangiw	T1A	Wed	19:00 - 19:50	5583	45
CHEN, Lizhong / lchendh	T1B	Thu	13:30 - 14:20	2406	45
MAO, Jianda / jmaoao	T1C	Wed	19:00 - 19:50	2504	30

- Tutorials start from Week 2 (Feb. 5-9).

3. COURSE DESCRIPTION

Credits: 3

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 <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

15%: WeBWorK, Course ILOs: 1, 2, 3, 4,

10%: Assigned problems for each chapter. After each chapter, 5-10 problems will be assigned on canvas. Students are required to solve all these problems and submit their solution on canvas before the specified deadline. Please note that only 2 problems out of these assigned one for each chapter will be graded. Un-attempted problems may also result in deduced marks. Course ILOs: 1, 2, 3, 4,

25%: Midterm exam. ONE-hour exam, April 9 (Tuesday), 7pm-8pm. Coverage: chapter 1-2. Course ILOs: 1, 2

50%: 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 Closed-book, no notes and no calculators. More information will be given prior to the exams. No make-up exams for midterm exam.

6. Student Learning Resources

Main reference: Lecture slides prepared by instructors and posted on Canvas.

Study Reference:

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

7. Teaching and learning Activities

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

8. Tentative TEACHING SCHEDULE

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

1. Vectors in the plane and three dimensions
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 and level curves, 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
8. Lagrange multiplier

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