MATH 2011 Introduction to Multivariable Calculus

Course Outline – Fall Term 2023/2024

1. Instructor: Math2011 (L3) 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	L3	Mon/Wed	10:30 - 11:50	LTD	140
LIN Hangyu/hlinbh	T3A	Thu	11:00 - 11:50	LSK1007	35
LIN Hangyu/hlinbh	T3B	Wed	14:00 - 14:50	LSK1032	35
LIU Yonglin/yliuks	T3C	Wed	12:00 - 12:50	4504	35
LIU Yonglin/yliuks	T3D	Fri	15:00 - 15:50	LSK1027	35

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: Date to be announced. Course ILOs: 1, 2, 3, 4 (*Note that there will be no make-up midterm exam.*)

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.

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.

7. Teaching and learning Activities

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

8. TEACHING SCHEDULE for 24 classes in total

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

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

Topic 2. Vectors and Vector-Valued Functions: Class 4 – 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 – 16 (7 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 17 – 20 (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 21 – 24 (4 classes)**

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