The Hong Kong University of Science and Technology (Guangzhou)

UG Course Syllabus

Title: Introduction to Multivariable Calculus

Code: UFUG 2101

Course Credits: 3

Prerequisites: UFUG 1103 Calculus II or UFUG 1106 Honors Calculus II

Name: Xuechao Wang

Email: xuechaowang@hkust-gz.edu.cn

Office Hours: Every Tuesday 15:00 – 16:00, W1 415

Course Description

This course emphasizes a thorough study of vectors, vector functions, partial derivatives, multiple integrals, and vector calculus. Students should understand the basic concepts and techniques of vector calculus and be proficient at vector operations and multivariable calculus calculation. After taking this course, students will understand the following implementations of functions of several variables: limits, continuity, derivatives, and integration, and will be able to apply multivariable calculus in solving practical problems in the real world.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Understand the basic concepts/theories and know the basic techniques in multivariate functions, partial differentiation and multiple integration.

2. Effectively perform calculations of the gradients, directional derivatives, arc length of curves, area of surfaces, and volume of solid.

3. Solve problems involving maxima and minima, line integral and surface integral, vector calculus, Green's theorem, and Stokes' theorem.

4. Apply multivariable calculus methods to solve practical engineering problems.

5. Develop mathematical maturity to undertake higher level studies in mathematics and related fields.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

[List specific assessed tasks, exams, quizzes, their weightage, and due dates; perhaps, add a summary table as below, to precede the details for each assessment.]

Assessment Task	Contribution to Overall Course grade (%)	Due date
Mid-Term	30%	Week 6-8
Final examination	40%	Week 14+ (11-23 Dec 2024)
Written assignment	30%	Week 1-6, 8-13

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

[add to/delete table as appropriate]

Assessed Task	Mapped ILOs	Explanation
Calculate partial differentiations and multiple integrations	ILO1, ILO2	This task is designed to evaluate students' proficiency in explaining and applying the concepts of partial differentiation and multiple integration (ILO1), as well as to assess their accuracy in performing calculations related to these concepts (ILO2).
Apply partial differentiations and multiple integrations to solve practical engineering problems	ILO1, ILO3, ILO4	This task is aimed at evaluating students' capacity for critical analysis of their grasp of the foundational concepts (ILO1) and their computational skills (ILO3). Furthermore, it assesses their ability to apply this knowledge and these skills in addressing practical, real-world problems (ILO4).
Understand the rigorous reasoning behind practical facts and the proof of certain mathematical theorems related to vector calculus	ILO1, ILO5	This task focuses on evaluating students' comprehension and application of vector calculus through rigorous reasoning and proof of mathematical theorems (ILO1). And it supports ILO5 by cultivating mathematical maturity essential for pursuing higher-level studies in mathematics and related disciplines.

Grading Rubrics

Detailed rubrics for each assignment will be provided. These rubrics clearly outline the criteria used for evaluation. Students can refer to these rubrics to understand how their work will be assessed.

Final Grade Descriptors:

[As appropriate to the course and aligned with university standards]

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of subject matter, expertise in problem-solving, and significant creativity in thinking. Exhibits a high capacity for scholarship, going beyond core requirements to achieve learning goals. **The total score is in [85, 100].**
B	Good Performance	Shows good knowledge and understanding of the main subject matter, competence in problem-solving, and the ability to analyze and evaluate issues. **The total score is in [70, 85).**
C	Satisfactory Performance	Possesses adequate knowledge of core subject matter, competence in dealing with familiar problems, and some capacity for analysis and critical thinking. Shows persistence and effort to achieve broadly defined learning goals. **The total score is in [55, 70).**
D	Marginal Pass	Has threshold knowledge of core subject matter, potential to achieve key professional skills, and the ability to make basic judgments. Benefits from the course and has the potential to develop in the discipline. **The total score is in [40, 55).**
F	Fail	Demonstrates insufficient understanding of the subject matter and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline. **The total score is in [0, 40).**

Course AI Policy

The direct use of generative artificial intelligence (AI) tools in examinations or assignments is typically prohibited.

This is because these tools can produce detailed responses and solutions without the user demonstrating their own understanding or problem-solving process. The purpose of exams and assignments is to assess the individual's knowledge, comprehension, and ability to apply what they have learned. Using AI tools circumvents this process, undermining the educational objectives of developing critical thinking, problem-solving skills, and deep understanding of Calculus. It's allowed for students to use such AI tools only as supplementary aids, if permitted, for learning and not for assessment purposes.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include explanations for the deduction of points. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

[If applicable, explain the policy for resubmitting work or reassessment opportunities, including conditions and deadlines.]

The deadline for each assignment will be notified while the homework is assigned. **No late homework will be accepted. Each assignment can only be submitted and assessed once**, emphasizing the importance of diligence and thoroughness in initial attempts. For students who seek clarification or have concerns regarding their assignment scores, it is imperative to initiate communication with the instructor within a specified timeframe—**five working days from the receipt of their grades**. This prompt action ensures that any discrepancies or misunderstandings can be addressed in a timely manner.

The decision to grant a reassessment opportunity for a student's exam performance rests solely with the instructor. This discretion allows instructors to consider the individual circumstances surrounding a student's request, such as the nature of any errors or misunderstandings in the initial assessment, the student's overall performance and engagement in the course, and the policies of the academic institution. It underscores the importance of the instructor's role not only in evaluating academic performance but also in fostering a fair and supportive learning environment where students feel their concerns are heard and addressed appropriately.

Required Texts and Materials

Self-contained lecture notes will be provided.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

[Optional] Additional Resources

[List any additional resources, such as online platforms, library resources, etc.]

1. *Calculus for Scientists and Engineers* by Briggs, William L.; Cochran, Lyle; Gillett, Bernard (available at the library, e-book will be provided by the instructor on a chapter-by-chapter basis)

2. *Thomas' Calculus: Early Transcendentals* 13th Edition (available online)

Tentative Schedule

Week 1: Lines, Planes and Curves	ILO 1-4
Week 2: Multivariable Functions, Partial Derivatives	ILO 1-4
Week 3: Chain Rule, Directional Derivatives	ILO 1-4

Week 4: Tangent Plane, Local Extrema	ILO 1-4
Week 5: Lagrange's Multiplier, Optimizations	ILO 1-4
Week 6: Double Integrals	ILO 1-4
Week 7: Triple Integrals	ILO 1-4
Week 8: Triple Integrals Continued	ILO 1-4
Week 9: Line Integrals, Conservative Vector Fields	ILO 2-5
Week 10: Curl Operator, Green's Theorem	ILO 2-5
Week 11: Parametric Surfaces, Surface Integrals	ILO 2-5
Week 12: Surface Flux, Stokes' Theorem	ILO 2-5
Week 13: Divergence Theorem	ILO 2-5