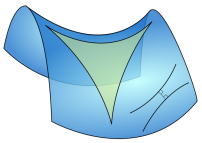

MATH 4223
Differential Geometry
2024-25 Fall

https://canvas.ust.hk/courses/59218

Lecture

Time	Tuesdays and Thursday 3:00pm-4:20pm
Venue	Room 1410
Instructor	**Prof. Frederick Tsz-Ho FONG**
E-mail	frederick.fong@ust.hk
Office	Room 3481, Department of Mathematics

Tutorial

Time	Fridays 7:00pm-7:50pm
Venue	Room 1027, LSK
Teaching Assistant	**YOU Lei**
E-mail	lyou@connect.ust.hk

Course Description

Course outline: differential geometry of curves and surfaces in Euclidean spaces: curvature and torsion, Frenet-Serret frame, regular surfaces, first and second fundamental forms, curvatures, covariant derivatives, Theorema Egregium, Codazzi-Mainardi equations, geodesics, Cartan's structural equations, Gauss-Bonnet theorem.

Credits: 3

Prerequisites: Multivariable Calculus (MATH 2023/2011) and Linear Algebra (MATH 2121/2131).

Intended Learning Outcomes (ILOs)

Upon completion of this course, students are expected to:

(1) acquire workable knowledge on the fundamental concepts of regular curves and surfaces in Euclidean spaces;
(2) acquire necessary background for further studies in differential geometry, general relativity, and related fields;
(3) appreciate the beauty of differential geometry, especially the Gauss-Bonnet's Theorem.

Assessment and Grading

Homework: There will be 4 or 5 problem sets. Students should submit each homework in form of a clearly written and scanned or a LaTeX-typed PDF on the Canvas system before the deadline. No late homework is accepted. You can form a group of at most three students to work on the homework together, and submit one copy of the homework as a team. All team members in the same group will receive the same score.

Examinations: There will be a 3-hour midterm exam during Week 6-8 (exact date to be confirmed), and a 3-hour final exam arranged by ARO.

Make-up midterm policy:

- Under any circumstance, students who are unable to attend the midterm exam will **not** be offered a make-up test that takes place after the regular exam session.
- For students who have valid reasons for missing the midterm (such as time crash with another midterm), the instructor may approve an early midterm, or assign the midterm marks according to the final exam performance.
- On the other hand, for students who miss the midterm without a valid reason, the midterm score will be regarded as 0. This includes self-claimed sickness without any medical statement.

Make-up final exam policy:

For final exams, the course will follow the make-up exam policy set by ARO. Approval from the instructor, the dean, and ARO will be needed for applying for a make-up final exam, and students need to complete the make-up final exam within 1 week after the approval decision from ARO. In any circumstance, the make-up final exam will use a different set of problems, and there is no guarantee that the level of difficulty remains the same as the regular sitting.

Presentation (optional): Students who aim at A- or above are required to submit a presentation video on Canvas, explaining the proof of a major theorem in the course. Students must hand-write the content (on the whiteboard or on a tablet) while doing the presentations. Prepared PowerPoint slides are **not** allowed. It is acceptable to occasionally look at references and notes during the presentation, provided that you could demonstrate your clear understanding of the content.

Grading Scheme:

This course will be assessed using **criterion-referencing**, and grades will **not** be assigned using a curve (or a surface). Your course total will be calculated by taking the **maximum of two weighting schemes** – in order to encourage students to work harder in the final exam in case the midterm result is not desirable:

	Scheme A	Scheme B	Address ILOs
Homework	10%	10%	1, 2, 3
Midterm	45%	5%	1, 2, 3
Final	45%	80%	1, 2, 3
Course Total	100%	95%	

Letter Grades: Students should aim at getting a course total of 85% or above for A-/A/A+, and about 60% or above for B-/B/B+. For getting A- or above, students will need to achieve 85% of the course total, **and** submit a video presentation which demonstrates clear and accurate understanding of the chosen topic. Without a satisfactory submission of the presentation video, your grade will be capped by B+. For students who do not meet the 85%-cutoff, submission of a presentation video will **not** add bonus marks to the course total.

Grade Descriptors:

Grades	Short Description A	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of differential geometry taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of abstract manifolds, Riemannian geometry, general relativity, and related fields.
B	Good Performance	The student has mastered most computational techniques of differential geometry 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.

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 – especially those in pure mathematics – is not quite reliable. Students should be critical of the response generated by AI and do not blindly copy the generated responses to your homework.

Textbooks and References

References: The major reference is the instructor's lecture notes posted on Canvas (only Part 1: Differential Geometry in Euclidean Space will be needed). In addition, the following reference books are recommended:

(1) *Differential Geometry: curves-surfaces-manifolds*, Third Edition by Wolfgang Kühnel
(2) *Differential Geometry of Curves and Surfaces* Manfredo P. do Carmo
(3) *A Comprehensive Introduction to Differential Geometry, Vol. 1*, Third Edition by Michael Spivak

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.