

Differential Geometry I
Course Outline
Course 7412005 Section 01, Spring 2020
Mondays 17:00 - 17:50, Thursdays 10:00 - 11:50, Room: E1-1 #136
Chungbuk National University
Updated on 24 March 2020

Instructor: Dr. Byungdo Park

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Office hours: Tuesdays 16:00–17:00 at E1-1 #110 or by appointment.

Class webpage: Announcements, homework, exam schedules and other relevant information will be posted on the following webpage: https://byungdo.github.io/teaching/s2020_dg1.html which is also accessible via instructor's webpage: <https://byungdo.github.io/>

Textbook:

- Martin M. Lipschutz, *Schaum's Outline of Differential Geometry*, 1st Edition (1969), McGraw-Hill Education, ISBN-13: 9780070379855. **Caution:** The instructor **does not** recommend using Korean translation of this textbook, and will neither accommodate nor understand its users. It must be at your own risk if you want to use it.

References:

- Barrett O'Neill, *Elementary Differential Geometry*, Revised 2nd Edition (2006), Academic Press, ISBN-13: 9780120887354
- Manfredo P. do Carmo, *Differential Geometry of Curves and Surfaces: Revised and Updated Second Edition* (Dover Books on Mathematics) Updated, Revised Edition (2016), Dover Publications, ISBN-13: 9780486806990
- Manfredo P. do Carmo, *Differential forms and applications*, Springer-Verlag Berlin, ISBN-10: 3540576185
- Shoshichi Kobayashi, *Differential Geometry of Curves and Surfaces*, translated in Korean by B. Kim (2002), Cheongmoongak, ISBN-13: 9788970881751

Prerequisites: A solid coursework on calculus and linear algebra will help. Geometry for teachers 1 and 2 (7412074, 7412075) are recommended. The instructor does not dissuade students without meeting the prerequisite criteria registering for this course at his/her own risk.

Corequisites: None. The instructor highly recommends taking “Functions of Several Variables (7412065)” along with this course.

Course description: This is the first semester course of an year-long course “Differential Geometry” consisting of Differential Geometry 1 (7412005) and Differential Geometry II (7412006). We

shall study a local theory of curves as well as their invariants curvatures and torsions, Frenet formulae, tangent maps, isometries in \mathbb{R}^3 , congruence of curves, as well as basic concepts of a surface in \mathbb{R}^3 .

Course objectives: At the end of the course students should be able to:

- Write an arc-length parametrization of a regular curve.
- Compute curvature and torsion at a point of a given curve in both unit-speed and arbitrary-speed cases.
- Say when two given curves are congruent.
- Know what a surface in \mathbb{R}^3 means and give parametrizations to a few typical examples.
- Shape an overarching perspective on secondary school geometry, vectors, and calculus curricula.

Details on problem solving: Problems arising in this course will be requiring proofs and calculations based on the mathematical discourse in class. Through dialogues and discussions during each lecture as well as the instructor's office hours, the instructor will guide students approaching to problems that they will have to address.

Details on class proceeding: The instructor will give lectures on the material following the weekly lesson plan and assign weekly homework problems. Some of problems will be assigned as a team project, for which each student has to belong to one of groups and collaboratively discuss and work on those problems. Each group has to give an in-class presentation on team project problems at least once.

Grading policies: 35% from midterm exam, 35% from final exam, 15% from homework, 5% from group presentation, and 10% from attendance.

Homework policies: A list of homework problems will be posted on the class webpage roughly in weekly basis. Late homework will be accepted. The instructor will assign as many homework problems as it is needed to master the subject. The instructor will scan through each submitted homework and assign a score 2, 1, or 0 depending on quality of work. The homework score for the total grade will be calculated based on the following formula: $(\sum_{i=1}^h h_i \cdot n_i) / (\sum_{i=1}^h 2 \cdot n_i)$, where h is total number of homework assignment, h_i is the score for the i^{th} homework score, n_i is the number of problems in the i^{th} homework.

Attendance policies: Attendance data will be collected in every class meeting and will be used for determining your final grade. In a class meeting consisting of two-consecutive class hours, there will be only one attendance call, but if you miss it, it will be recorded as a 2-hour absence. You will get a grade F if you have missed more than 25% of class meeting hours. Up to 5 hours of absence there is no penalty. After that, you lose 1% of total score for an absence to each 50-minute long class meeting, with a maximum total loss 10% from your total score. If you have permissible reasons for your absence in accordance with the Regulation on Academic Management of the CBNU Article 52(1) (충북대학교 학사운영규정 제52조(공결승인) 제1항), you will need to contact

the Department Assistant to follow the procedure for getting an approval on your absence bringing proper documentation as proof. That said, you have to fill out a form and submit it along with appropriate proofs before the absence or after seven days of the date of absence.

Assessment of group presentation: All group members in each group will receive the same score, with an exception that the student who gave the presentation will receive an additional 1% of the total score subject to the same maximum. For example, if a group of student has obtained 4 out of 5% from the group presentation, the speaker will get full 5%.

Assessment of learning: The assessment will be primarily done by the abovementioned grading policy. Nonetheless, the instructor will also take into account students' devotions and efforts for this course as well as their enthusiasm as a future educator so that those qualitative elements are not going to be neglected.

Weekly lesson plan:

Week 1: Concept of a curve (regular curves, arc-length)

Week 2: Concept of a curve (arc-length parametrization), Curvature and torsion (tangent planes)

Week 3: Curvature and torsion (curvature, principal normal vectors)

Week 4: Curvature and torsion (binormal vectors, osculating planes, rectifying planes)

Week 5: The theory of curves (Frenet apparatus, involutes)

Week 6: The theory of curves (evolutes)

Week 7: Leeway (problem sessions, team project presentations)

Week 8: Midterm exam, Vector functions of a vector variable

Week 9: Vector functions of a vector variable (concept of a tangent map, inverse function theorem)

Week 10: Isometries in \mathbb{R}^3

Week 11: Congruence of curves

Week 12: Concept of a surface (Parametrized regular surfaces)

Week 13: Concept of a surface (Simple surface, tangent planes, normal lines)

Week 14: Leeway (problem sessions, team project presentations)

Week 15: Make-up classes if nessary, team project presentation, and final exam.

Accommodating disabilities in learning and assessment: The instructor is committed to providing access to all students. If you need accommodation in classroom or in assessment, you are encouraged to set up an appointment with the instructor at your soonest availability so that we can figure out the best way to accommodate you. Possible accommodations include, but not limited to, provision of materials from lectures, permission to hire an assistant for taking notes, audio-recording lectures, and aid/assistant devices, extension of due dates for assignments, alternative assessment for in-class presentations, extension of exam hours, and provision of an accommodating exam locations and exam sheets.

Academic integrity: It is expected that you will complete all exams without giving or receiving help from anyone. The minimum penalty for giving or receiving help on an exam is a grade of 0 on that test. Electronic devices are not allowed in any in-class exam. You may talk to other students about the homework but you must then complete the homework yourself. If your homework is identical to someone else's in the class, you will be summoned to explain your solution in front of the instructor. A failure in justifying your solution would lead score 0 to that homework. The abovementioned violation of academic integrity can be a subject of filing a report in accordance with the university policy.

Disclaimer: Lectures in this course will be given in Korean, but most of written materials will be in English. For example, the course syllabus, most of boardwork, exam problems, homework, solutions to exams, course webpage, announcements, but not limited to those. English sentences to be used in this course should be understandable enough based on the regular Korean public high school curriculum. Nonetheless if your English skill is not competent enough to follow this course or understanding announcements, it is your responsibility to ask the instructor to also provide an explanation in Korean. The instructor will take those questions under an attitude of helping students' understanding, but taking into account the contents of each question, he may reject the question or advise the questioner to visit him during his office hour to ask the question about Korean translation.

사전고지: 본 강좌에서 강의는 한국어로 이루어집니다만, 글의 경우 대부분 영어가 사용될 것입니다. 수업계획서, 칠판 판서의 대부분, 시험문제, 숙제, 시험문제에 대한 풀이, 강좌의 웹페이지, 공지사항 등이 예가 될 수 있으며, 이상 열거한 것들로 한정되지 않습니다. 본 강좌에서 사용될 영어 문장들은 한국의 공립 고등학교 정규 교과과정을 기초로 할 때 충분히 이해될 수 있어야 합니다만, 만약 수강생 본인의 영어실력이 본 강좌를 따라오거나 공지사항을 이해하기에 충분치 못하다면, 담당교수에게 한국어로 추가 설명을 요청하는 것은 학생 본인의 몫입니다. 담당 교수는 학생들의 이해를 도우려는 자세로 질문을 받을 것이지만, 질문의 내용에 따라 답을 하지 아니할 수도 있고, 면담시간에 개별 방문하여 질문하도록 안내할 수도 있습니다.

Updates and make-up lesson schedules due to a new Corona Virus (COVID-19) outbreak: Following the decision of the university center (교무과-2459, 2020.02.12.), the first day of class has been deferred to March 16th. Also following another decision of the university (학사지원과-2288, 2020.03.05.), we shall not meet during the period March 16th to 28th. For those 6 contact hours, we shall have make-up classes on Tuesdays, March 31st, April 7th, 14th, 21st, 28th, and May 12th at 16:00–16:50 at E1-1 Room 136. Please stay tuned for any further updates which will be posted on the course webpage.

- **Update as of 2020-03-24:** The university center has decided not to meet in classroom for an extra week (학사지원과-2983, 2020.03.23). Accordingly, we shall not meet during the period March 29th to April 4th. We make-up those additional 3 contact hours on May 19th, 26th, and June 2nd at 16:00–16:50 at E1-1 Room 136. Additionally, we reschedule our March 31st make-up session on June 9th at 16:00–16:50 also at E1-1 Room 136.