

**Differential Geometry II**  
**Course Outline**  
**Course 7412006 Section 01, Fall 2022**  
**Tuesdays 13:00 - 13:50, Thursdays 14:00 - 15:50, Room: E1-1 #136**  
**Chungbuk National University**  
Updated on 01 September 2022

*This document prevails whenever interpretations of the course syllabus (the version in 개신누리) and that of this document conflict. This document contains terms and conditions on how this class will be administered throughout the semester. Registering for this class means you agree on plans, policies, and details in this document. You MUST drop this course if you disagree with any item listed in this document.*

**Instructor:** Dr. Byungdo Park

**Email:** byungdo@g.cbnu.ac.kr (alternatively, use byungdopark1@gmail.com if it does not work)

**Office hours:** Tuesdays 18:00–18:50 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/f2022\\_dg2.html](https://byungdo.github.io/teaching/f2022_dg2.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 main textbook for this course is the English version. The instructor **does not** recommend using Korean translation of the main textbook for this course, and will neither accommodate nor understand users of a Korean-translated textbook. It must be at your own risk if you want to use it. All your exam problems will be given in English, so if you use a Korean-translated textbook, it might act toward your disadvantage in exams.

**References:**

- Richard S. Millman and George D. Parker, *Elements of Differential Geometry*, 1st Edition (1977), Pearson, ISBN-13: 9780132641432
- 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*, 1st Edition translated in English (2019), Springer-Verlag, ISBN-13: 9789811517389

**Prerequisites:** Differential Geometry I (7412005). It is desirable to take this course after taking the following list of courses. You may still take this course and master materials successfully if you look up and teach yourself necessary concepts and results from the following list of courses.

- Geometry for teachers I, II (7412074, 7412075).
- Linear Algebra and Mathematics Education I, II (7412068, 7412069).
- Functions of Several Variables (7412065).
- General Topology I (7412016).

The instructor does not dissuade students without meeting the prerequisite criteria registering for this course at his/her own risk.

**Course description:** As a continuation of Differential Geometry I (7412005), we study the surface theory of Gauss. We shall begin with a definition of surface in  $\mathbb{R}^3$ , learn how to analyze and classify curved surfaces locally. It will then lead us to Gauss' theorema egregium (an awesome theorem), and the course will reach at its climax by stating and proving the Gauss-Bonnet theorem bridging two totally different kinds of mathematics in one equation.

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

- Know what a surface in  $\mathbb{R}^3$  means and give parametrizations to a few typical examples.
- Understand the meaning of normal curvature and principal curvatures as its extrema.
- Calculate Gauss and mean curvatures and analyze the meaning of numbers obtained.
- Extract geometric meanings from Gauss' equation.
- Understand the contents of Gauss' theorema egregium.
- Appreciate the statement and proof of Gauss-Bonnet theorem.
- Create an online learning contents such as YouTube videos for sharing knowledge with a broader audience.
- Shape an overarching perspective on secondary school geometry, vectors, and calculus curricula.

**Details on class proceeding:** The instructor will give lectures on the material following the weekly lesson plan and assign weekly homework problems. He will also encourage you to participate in a Project-Based Learning to strengthen your competence as a teacher also in online, remote setup.

**Grading policies:** 25% from each of two 50-minute midterm exams (total 50%), 42% from final exam, and 8% from attendance. Up to an additional 3% total score credit for your PBL project. Absolute evaluation [A: 100–90 points, B: 89.99–80 points, C: 79.99–70 points, D: 69.99–60 points, F: less than 60 points] with curving. Here the curving means a horizontal shift of the bell-shaped curve of %-score distribution in either directions using a rational constant which is determined at the discretion of the instructor. The only exception (that is unlikely to happen) to the absolute evaluation: If your total score is less than 60 points after curving and greater than or equal to 60 points before curving, then D is assigned instead of F. Grading policies in the attendance policies, academic integrity policies, and classroom attitude policies are applied in higher priority (in this order) than the above grading policies. Those who are in their final semester and have to show up to work during the semester, special rules apply in accordance with the university policies (cf. 충북대학교 학칙 제34조의2, 학사운영규정 제86조의3).

**Homework policies:** A list of homework problems will be posted on the class webpage roughly in weekly basis. The instructor will assign as many homework problems as it is needed to master the subject. However, homework will not be collected, will not be graded, and will not be used as a constituent of your final score. Instead, some of your exam problems will be identical to your homework problems.

**Classroom attitude policies:** The instructor may apply up to 5 points per day (up to 10 points per day for repeated cases) of deduction of your total score against any of your attitude which the instructor views it inappropriate. The sum of total score deduction due to these policies may not exceed 20 points throughout the semester. Inappropriate attitudes are (i) anything you do in the classroom that disturbs and/or distracts the instructor or other students or (ii) disturbing and/or distracting the instructor from administering this class. If you violate, you will be notified via email registered in 개신누리 and it gets confirmed if you do not dispute in a written form in 7 days.

**Attendance policies:** (1) Attendance data will be collected in every class meeting and will be used for determining your final grade. You will get a grade F if you have missed more than 25% of class meeting hours. Up to 3 hour of absence there is no penalty on your score. After that, you lose 1% of total score for an absence to each 50-minute long class meeting, with a maximum total loss 8% from your total score.

(2) 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 your department secretary 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.

(3) If you responded to an attendance call and leave the classroom (even if you come back later) while the lecture is still going on, you will be considered to be absent for that attendance call *if you report later to the instructor that you left during the class within that day's class*. If you don't report and your arbitrary and sudden leave gets caught, you will be considered to be absent for that day's class and it will be treated as a violation of classroom attitude policies.

(4) Any dispute about in-class attendance records must be made before the instructor physically leaves the classroom after that day's class meeting. If your attendance call is responded by a person other than you, a penal responsibility will be pursued against responsible individuals.

**Assessment of Project-Based Learning (PBL):** To submit your PBL project for an extra credit, you should record a 20-minute long video lecture about one of the following:

- A sample lecture on any topic listed on the syllabus of this course.
- A sample lecture on a concept from secondary school geometry curricular.

You should submit the video in a form of a YouTube video link by choosing the sharing option “unlisted(일부공개).” Your video will be disclosed to your classmates in this course as a part of a YouTube playlist. Registering to this course would mean that you accept sharing your video lecture with your classmates via YouTube. You may turn your video into “private” or even delete the video after your letter grade for this course is assigned. The assessment will be done as follows: 3/3 all in all good work. 2/3 lacking important examples, theorem, proofs or there are significant mathematical errors. 1/3 overall poor contents of the material. 0/3 no hand-in or a reuse of recording submitted to the instructor in the past.

**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.

### **Important dates:**

- Thursday September 15th 16:30–17:30 – Guest lecture: “Manifolds, and rotations of manifolds with fixed points” 장동훈 교수님(부산대 수학과).
- Tuesday September 27th – CBNU Anniversary. Make-up date: TBA
- Thursday November 3rd 16:30–17:30 – Guest lecture: “쌍곡기하 산책” 김영주 교수님(건국대 수학교육과).

### **Weekly lesson plan:**

Week 1: Review of concept of a surface

Week 2: The first and second fundamental forms (The 1st fundamental form and examples)

Week 3: The first and second fundamental forms (Normal curvature) – Practice teaching week: Online lectures using recorded videos

Week 4: The first and second fundamental forms (Principal curvature) – Practice teaching week: Online lectures using recorded videos (September 20th only)

Week 5: The first and second fundamental forms (principal directions, Gauss curvature, mean curvature) – Practice teaching week: Online lectures using recorded videos

Week 6: The first and second fundamental forms (Lines of curvature, Rodrigues' formula, asymptotic lines, conjugate families of curves.), a 50-minute exam covering Chapters 8 and 9 (up to the 1st fundamental form). – Practice teaching week: Online lectures using recorded videos (October 6th only)

Week 7: Problem session

Week 8: Problem session

Week 9: Theory of surfaces (Gauss-Weingarten formula and Gauss theorema egregium)

Week 10: Theory of surfaces (Some theorems on the surface in the large)

Week 11: Intrinsic geometry (Geodesic curvature)

Week 12: Intrinsic geometry (Geodesics)

Week 13: Intrinsic geometry (Gauss-Bonnet formula)

Week 14: Intrinsic geometry (Gauss-Bonnet theorem)

Week 15: PBL presentations. 100-minute final exam.

**Make-up lesson plan during the teaching observation period:** Most of students taking this course will be participating in the teaching observation around late October and early November. The instructor will make up lectures for those two-week period by providing online video lectures on CBNU eCampus. Since your teaching observation will be considered as absences in official causes, your attendance will not be collected for those video lectures, however, you are required to complete homework assignments from those. Also everything covered in those online video lectures will be included in the coverage of your final exam.

**Dispute policies:** (1) You may set up an appointment with the instructor to get information about the raw data (such as your exam scores, attendance data, etc) which will consist of your total score. For that, you have to send an email to the instructor to set up an appointment. Typically the meeting will take place during the office hour (you cannot walk-in for this purpose; set up an appointment first) but if you have a class at the same time, you should attach your time table showing that you have another class during the office hour.

(2) If you do not set up an appointment and do not dispute about the raw data, the instructor will have to assume that you give up your right to dispute. After the final exam, the instructor will announce the last day for dispute. After this date, the instructor will only look into whether there is any error in entering your final grade and will dismiss all inquiries on the raw data.

**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. Electronic devices are not allowed in any in-class exam. If you violate any of these policies, you receive score zero to that exam at the discretion of the instructor. In addition, your case will be handled through the standard procedure of the university. Note that a use of your smartphone during an exam is simply a cheating.

**Email policies:** All emails addressed to the instructor should have a title containing the course title, name, and a brief summary as well as a body starting with "Dear Professor Last name" and ending with "Sincerely, Your full name", which contains greetings, your name and department, a brief and clear purpose written politely. Any email deviating from this format will not be accepted and will be dismissed without any rejection reply. The corresponding disadvantages are solely and entirely on the student.

**이메일 작성규칙:** 담당교수에게 보내지는 모든 이메일의 제목에는 과목명, 신원, 요지가 포함되어 있어야 하며, 본문은 반드시 "OOO 교수님께"로 시작하여 인사, 신원, 용건을 간단 명료하고 예의 바르게 기술한 후 "OOO 올림" 또는 "OOO 드림"으로 끝나야 합니다. 이 형식에 어긋난 이메일은 접수하지 않으며, 반려회신 없이 종결합니다. 이에 따른 불이익은 전적으로 학생의 단독 책임입니다.

**English usage policies:** 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.

**영어 사용 정책:** 본 강좌에서 강의는 한국어로 이루어지지만, 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 하지만, 만약 수강생 본인의 영어실력이 본 강좌를 따라오거나 공지사항을 이해하기에 충분치 못하다면, 담당 교수에게 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.