Differential Geometry II
Course Outline
Course 7412006 Section 01, Fall 2025
Wednesdays 14:00 - 15:50, Thursdays 15:00 - 15:50, Room: E1-1 #136
Chungbuk National University

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@chungbuk.ac.kr

Office hours: Thursdays 14:00–14:50 at E1-1 Room 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/f2025_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 learn how to analyze and classify curved surfaces locally. It will then lead us to Gauss' theorema egrigium (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:

- Understand the meaning of normal curvature and principal curvatures as its extrema. (Convergent Major Competency)
- Calculate Gauss and mean curvatures and analyze the meaning of numbers obtained. (Comprehensive Thinking and Creative Problem-Solving Competency)
- Extract geometric meanings from Gauss' equation. (Convergent Major Competency)
- Understand the contents of Gauss' theorema egregium. (Comprehensive Thinking and Creative Problem-Solving Competency)
- Appreciate the statement and proof of Gauss-Bonnet theorem. (Comprehensive Thinking and Creative Problem-Solving Competency)
- Create an online learning contents such as YouTube videos for sharing knowledge with a broader audience. (Self-Management Competency)
- Shape an overarching perspective on secondary school geometry, vectors, and calculus curricula. (Global Competency)

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: 46% from 100-minute midterm exam, 46% from 100-minute 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: less than 80 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. 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. 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 come to the class after the attendance call or leave the classroom for any reasons before the class ending time, you will be considered as absent for that 50-minute session. If you came after the attendance call but before the beginning of the second of two consecutive 50-minute sessions, you must report your presence before the second session starts so that you will be considered to be present during the second session. Otherwise, you may be considered as absent for the entire consecutive sessions.

(4) Any dispute about in-class attendance records must be made before the instructor physically leaves the classroom after that day's class meeting.

(5) If you leave the classroom after the attendance call cumulatively more than 3 times during the semester, each time beyond this limit will be considered as a violation of classroom attitude policies. If you leave the classroom after the attendance call but have obtained a permission from the instructor before class begins, it will not be counted toward this cumulative limit.

Makeup exam policies: If you could not take any exam and would like to take a makeup exam to the missing exam, you must follow the following guideline:
`https://byungdo.github.io/teaching/makeup.pdf`

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. The Google Forms link for your submission will be available on the course webpage.

Program Learning Outcomes Assessment: This course contributes to the improvement of the following major competencies and learning outcome indicators:

1. Convergent Major Competency
   - Indicator 1-2 (Mathematical Software Utilization Skills):
   * Surface visualization and curvature calculation assignments using Mathematica/GeoGebra (3 times per semester)
   * Assessment: Evaluation of software utilization frequency and deliverables

2. Comprehensive Thinking and Creative Problem-Solving Competency
   - Indicator 2-2 (Teaching Plan Assessment Score):
   * Development of teaching plans that reflect the connection between differential geometry concepts and secondary mathematics
   * Assessment: Scoring based on the teaching plan evaluation rubric

3. Self-Management Competency
   - Indicator 3-1 (Participation in Extracurricular Programs):
   * Educational YouTube video production as part of PBL project, recognized as departmental

extracurricular activity
* Assessment: Quality and completion evaluation of produced videos (3-point scale)

4. Global Competency
- Indicator 4-1 (English-Medium Course Completion Rate):
* Use of English textbook and learning of English terminology
* Assessment: Evaluation of understanding of mathematical terms in English (reflected in midterm/final exams)

The assessment results for each indicator will be compiled at the end of the semester, submitted to the Department Performance Management Committee, and reflected in the course CQI report.

Important dates:

- Thursday October 9th – Hangeul Proclamation Day. Make-up date: TBA
- Wednesday October 8th – Chuseok Holiday observed. Make-up date: TBA

Weekly lesson plan:

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

Week 2: The first and second fundamental forms (Normal curvature)

Week 3: The first and second fundamental forms (Principal curvature)

Week 4: The first and second fundamental forms (Gauss curvature, mean curvature)

Week 5: The first and second fundamental forms (Principal directions)

Week 6: The first and second fundamental forms (Lines of curvature, Rodrigues' formula, asymptotic lines, conjugate families of curves.)

Week 7: Problem session

Week 8: Problem session, 100-minute midterm exam.

Week 9: Theory of surfaces (Gauss-Weingarten formula and Gauss theorema egregium) – Practice teaching week: Online lectures using recorded videos

Week 10: Theory of surfaces (Some theorems on the surface in the large) – Practice teaching week: Online lectures using recorded videos

Week 11: Intrinsic geometry (Geodesic curvature) – Practice teaching week: Online lectures using recorded videos

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.

No video lectures provided for students' absence in any causes: The instructor may have to change the course's plan and give some of lecture via online in accordance with the 충북대학교 원격수업운영지침 제15조(결강 및 보강)제2항. However, the instructor will not provide recorded video of any part of class meetings even if one or more students' cause has an official cause listed in 충북대학교 학사운영규정 제52조(공결승인)제1항. Nonetheless, during your practice teaching period (교육실습I), video lectures will be provided for you as an exception.

Make-up lesson plan during the teaching observation period: Most of students taking this course will be participating in the teaching observation from late October to early November for 3 weeks. The instructor will make up lectures for those three-week period by providing online video lectures on CBNU eCampus. Since your teaching observation will be considered as absences in offical 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) The instructor will announce a date and an interval of time for you to see (and dispute if you wish) your graded papers. For that you have to respond and set up an appointment by email until the specified deadline. If you respond, the instructor will give you a specified date, time, and location for you to show up. There will be an option to give up your rights to dispute and just get notified your scores by email.

(2) If the specified date and an inverval of time in the announcement conflicts with your other classes or other equivalently official schedules, you may request a rescheduling by attaching your time table or a relevant document showing that you have other official matters.

(3) If you do not respond by the deadline in each announcement, the instructor will have to assume that you give up your right to dispute and the grading is flawless. For example, if you inquire after your letter grade is assigned, the instructor will only look into whether there is any error in entering your final grade and will dismiss all inqueries 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 acoommodate 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 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, 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.