Differential Geometry II
Course Outline
Course 7412006 Section 01, Fall 2026
Tuesdays 15:00 - 15:50, Wednesdays 14:00 - 15:50, Room: E1-2 #306
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.

Instructor: Dr. Byungdo Park

Email: byungdo@chungbuk.ac.kr

Office hours: Tuesdays 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/f2026_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.

General course guideline:「수업운영 기본지침」(2026. 6. 24. 제정) is available at
`https://byungdo.github.io/teaching/guideline-2026-06-24.pdf`
※ 본 강좌에만 적용되는 특칙:「수업운영 기본지침」(2026. 6. 24. 제정)제9조제1항의 표에도 불구하고, 75점 미만에 대한 부여등급은 C0로 한다.

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:

- October 27th, 28th – Business trip. Make-up: Online
- November 3rd, 4th – Business trip. Make-up: Online

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) – Online lectures using recorded videos

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

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.