

Topics in Geometry I
Course Outline
Course 9114001 Section 01, Spring 2020
Class meeting period 16.07.2020-05.08.2020
Mondays and Thursdays 09:00 - 11:50, Tuesdays and Fridays 12:00 - 14:50,
Wednesdays 15:00 - 17:50, Room: E1-1 #140
Chungbuk National University

Instructor: Dr. Byungdo Park

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Office hours: Mondays to Fridays except Wednesdays 15:00–16:00, Wednesdays 14:00–15:00 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_tig1.html which is also accessible via instructor's webpage: <https://byungdo.github.io/>

References on geometry general:

- Claire F. Adler, *Modern Geometry : an integrated first course*, 2nd Edition (1967), McGraw-Hill, ISBN-13: 9780070004214
- Marvin J. Greenberg, *Euclidean and Non-Euclidean Geometries: Development and History*, 4th st Edition (2007), W. H. Freeman, ISBN-13: 9780716799481
- Robin Hartshone, *Geometry: Euclid and Beyond* (Undergraduate Texts in Mathematics), 1st Edition (2005), Springer New York, ISBN-13: 9780387986500
- Shoshichi Kobayashi, *From Euclid geometry to modern geometry*, translated in Korean by D. Won (1999), Cheongmoongak, ISBN-10: 8970881816

References on differential geometry:

- Martin M. Lipschutz, *Schaum's Outline of Differential Geometry*, 1st Edition (1969), McGraw-Hill Education, ISBN-13: 9780070379855
- 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

Prerequisites: Undergraduate courses Differential Geometry I (7412005) and Differential Geometry 2 (7412006). 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.

Course description: There are two primary components in this course. First, we shall review differential geometry of curves and surfaces through problems while revisiting also Euclidean, non-Euclidean, and projective geometry. Seeking connections between differential geometry and classical geometry as well as a reflection to secondary school geometry curricula is of particular interest. While doing so, we shall train ourselves for an ability of lucidly explaining and communicating logical thoughts on given problems to amplify teaching skills. Considering that this is a graduate-level course, we will also be interested in looking at panoramas of contemporary geometries such as Riemannian, symplectic, metric, and complex geometries. Another part of this course is a project-based learning (as known as PBL) for which each student will take initiatives for choosing and investigating a topic or a problem among advanced topics in geometry. The overall goal is to help students to get armed with a strength in microscopic details as well as a bird-eye view of the subject.

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

- Solve problems in differential geometry precisely and promptly.
- Clearly communicate ideas and logic for addressing given problems.
- Understand where to fit each topic learned in geometry courses (including this one) in historical timeline.
- Know what else are out there as advanced topics of geometry and attempt to learn at least one of them.
- Think about topics learned in geometry courses (including this one) in connection to the curricula in secondary mathematics education.

Details on problem solving: Problems arising in this course will be requiring proofs and calculations based on the mathematical discourse in class and/or the subjects students are supposed to know already. In addition there are components of PBL that students will have to teach themselves. 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: Every class meeting will consist of the following two components. In the first half, there will be an introductory lecture on topics including a problem solving session. There will be a 15-minute break at 75-minute mark, and the class resumes at 90-minute mark. In the second half, there will be a 30-minute long quiz and followed by a discussion on quiz problems. Students should be able to present their solutions and logically communicate. We shall exchange helpful feedback to improve teaching skills of all of us.

Last two or three class meetings will be devoted for in-class presentations of students' PBL activities and/or lectures on advanced topics in geometry. We shall also watch several videos overarching the subject we study. Lectures on advanced topics might be carried out in a form of an invited lecture of an external scholar.

Grading policies: 70% from in-class quiz, 20% from term paper or an in-class presentation, and 10% from attendance.

Assessment through in-class quizzes: There will be total twelve to fifteen 30-minute long in-class quizzes. Each quiz will consist of two problems and the style of questions will be similar to those of Public Secondary School Teacher Employment Exam. Three of your lowest quiz scores will be dropped, and the remainder will be used to calculate your quiz score. For those who participated in in-class presentation, 20% of the quiz score of that day will be given in extra with a maximum total score 100%. For example, if your quiz score of a day is 85% and you have presented your solutions, then your quiz score of that day will be 100%. If your score was 60% and have presented solutions, then it will become 80%.

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 three-consecutive class hours, there will be only one attendance call, but if you miss it, it will be recorded as a 3-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 term paper/in-class presentation: There will be a list of topics that you can choose. Nearing the end of semester, you will have to write a term paper about what you have taught yourself. 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. Alternatively, you may choose to give a standard 50-minute in-class presentation, in which case your lecture will be assessed by the above-mentioned rubric and your term paper will be waived. Only one person will be accepted to speak for each topic in first come first served basis.

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: Weekly quiz and review. Basics on smooth curves.

Week 2: Weekly quiz and review. Torsion and curvature, Frenet formulae (1)

Week 3: Weekly quiz and review. Torsion and curvature, Frenet formulae (2)

Week 4: Weekly quiz and review. Additional topics from curves.

Week 5: Weekly quiz and review. Local theory of surfaces (1)

Week 6: Weekly quiz and review. Local theory of surfaces (2)

Week 7: Weekly quiz and review. Local theory of surfaces (3)

Week 8: Weekly quiz and review. Local theory of surfaces (4)

Week 9: Weekly quiz and review. The Gauss theorem Egregium.

Week 10: Weekly quiz and review. Geodesic curvature, geodesics.

Week 11: Weekly quiz and review. Gauss-Bonnet theorem.

Week 12: Weekly quiz and review. Final summary of topics we have learned.

Week 13: PBL presentation. If no one volunteers for presentation, then we will do weekly quiz and review. Final summary of topics we have learned.

Week 14: PBL presentation. If no one volunteers for presentation, then we will do weekly quiz and review. Final summary of topics we have learned.

Week 15: PBL presentation. If no one volunteers for presentation, then we will do weekly quiz and review. Final summary of topics we have learned.

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.

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