Geometry and education
Course Outline
Course 7412062 Section 01, Fall 2020
Tuesdays 15:00 - 17:50, Room: E1-1 #116
Chungbuk National University

Instructor: Dr. Byungdo Park

Email: byungdo@chungbuk.ac.kr

Office hours: Mondays 17:00–17:50 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/f2020_ge.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: 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: 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. 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.
- 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. 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 components.

- An introductory lecture followed by an in-class problem session (Problem session: 25-minute long).
- Going over the problems from the problem session.
- An in-class quiz (25 minutes).
- Going over the quiz problems from the previous day.

Grading policies: 92% from in-class quiz and 8% from attendance.

Assessment through in-class quizzes: There will be total twelve to fifteen 25-minute long in-class quizzes. While working remotely, you may take longer time if needed stipulating that you stick to the academic integrity policy of this course. 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.

Attendance policies: 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 the number of absent hours will be counted but there will be no penalty on your total score. After that, you lose 1% of total score for an absence of each

50-minute-long class meeting, with a maximum total loss 8% 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 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:

- Saturday October 31st: Deadline to apply for an in-class presentation.

Weekly lesson plan:

Week 1: Weekly quiz and review. Basics on smooth curves. – *Online lectures using recorded videos*

Week 2: Weekly quiz and review. Torsion and curvature, Frenet formulae (1) – *Online lectures using recorded videos*

Week 3: Weekly quiz and review. Torsion and curvature, Frenet formulae (2) – *Online lectures using recorded videos*

Week 4: Weekly quiz and review. Additional topics from curves. – *Online lectures using recorded videos*

Week 5: Weekly quiz and review. Local theory of surfaces (1) – *Online lectures using recorded videos*

Week 6: Weekly quiz and review. Local theory of surfaces (2) – *Online lectures using recorded videos*

Week 7: Weekly quiz and review. Local theory of surfaces (3) – *Online lectures using recorded videos*

Week 8: Weekly quiz and review. Local theory of surfaces (4) – *Online lectures using recorded videos*

Week 9: Weekly quiz and review. The Gauss theorema Egregium. – *Online lectures using recorded videos*

Week 10: Weekly quiz and review. Geodesic curvature, geodesics. – *Online lectures using recorded videos*

Week 11: Weekly quiz and review. Gauss-Bonnet theorem. – *Online lectures using recorded videos*

Week 12: Weekly quiz and review. Applications of topics we have learned. – *Online lectures using recorded videos*

Week 13: Weekly quiz and review. Applications of topics we have learned. – *Online lectures using recorded videos*

Week 14: Weekly quiz and review. Applications of topics we have learned. – *Online lectures using recorded videos*

Week 15: Weekly quiz and review. Final summary of topics we have learned. – *Online lectures using recorded videos*

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.

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.

Policies on remote classes due to new Corona virus (SARS-CoV-2) outbreak: The class will follow the instructions from the university center regarding class operation policies due to the current Corona virus pandemic situation. Details of decisions made will be updated below in this document.

Tentative action plan as of 2020-06-20: If the university center decides to run classes remotely or if the status of new confirmed cases in Cheongju does not seem to be safe, stipulating that we follow policies and guidelines of the university center, we may choose to run this class remotely. The tentative action plan (which does not necessarily mean that we will be sticking to it) is as follows. Our remote classes will be using **video-recorded lectures** posted on Youtube. The **platform** will be CBNU e-Campus (Blackboard) wherein you will be able to find Youtube video links. Of course the instructor does not wish to run this course remotely, and very much hopes that the current pandemic situation gets concluded as soon as possible.

Announcement of remote classes as of 2020-07-20: As the primary rule, the university center has decided to run this course as a remote class for Fall 2020 semester. [학사지원과-6429 (2020.07.20.) 2020학년도 2학기 수업운영 방안 안내] Therefore, this course will go online throughout the semester. Please note the following:

- From the very first week of this course, we shall have remote classes using **video-recorded lectures** posted on Youtube. The **platform** will be CBNU e-Campus (Blackboard) wherein you will be able to find Youtube video links.
- By every Tuesday 15:00, you will be provided video recordings of lectures for 3 contact hours of that week. You will have to write an email to `byungdo@g.cbnu.ac.kr` with an answer key to the question (provided in the comment section of the video) for each contact hour. Please read the email (which will be sent nearing the first day of class) to learn more about attendance policies.

How to hand-in your quiz in remote class setup? You can hand-in your quiz via email to `byungdo@g.cbnu.ac.kr` by scanning it or using smart phone scanner apps. You have to hand-in your quiz until the next day 11:00. A late submission will not be accepted for any reasons. For example, let's look at the case of September the 8th (Tuesday).

(1) Video lectures and quiz problems will be posted on e-Campus by September the 8th 15:00.

(2) You have to submit by email your work by Wednesday, September the 9th 11:00.
Late submissions will NOT be accepted.

Academic integrity: While working on your daily quiz test, there is one very simple academic integrity policies you must follow.

- You are not allowed to refer other sources; printed, electronic, and in-person. In particular, an internet search or a discussion with any human being except self are strictly prohibited.

The grader will trust students and will not apply any prejudice. However, if the grader has found an evidence that you have violated this policy, the grader reserves the right to investigate by summoning you to come in to his office, reproduce and explain your own solutions in front of the chalkboard. If you cannot provide a coherent and consistent explanation to your own solution to a problem, the score to that problem will be zero. In addition to that, your other quiz solutions may possibly be a subject of investigation. The investigation session will be both video and audio recorded, and the result of the investigation (including video/audio recording of the investigation) can be reported to the department or the university center. You MUST drop this course if you cannot comply with this policy.