General Topology I
Course Outline
Course 7412016 Section 01, Spring 2024
Thursdays 10:00 - 11:50, Fridays 11:00 - 11:50, 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. You MUST drop this course if you disagree with any item listed in this document.

Instructor: Dr. Byungdo Park

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Office hours: Wednesdays 15:00–15:50 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/s2024_top1.html which is also accessible via instructor's webpage: https://byungdo.github.io/

Textbook:

- Martin M. Lipschutz, *Schaum's Outline of General Topology*, 1st Edition (1965), McGraw-Hill Education, ISBN-13: 9780071763479. **Caution:** 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.

References:

- James R. Munkres, *Topology*, 2nd Edition (2000), Prentice Hall, ISBN-13: 9780131816299
- Fred H. Croom, *Principles of Topology* (Dover Books on Mathematics) Updated, Revised Edition (2016), Dover Publications, ISBN-13: 9780486801544
- Allen Hatcher *Notes on Introductory Point-Set Topology*, course note available for download at: https://pi.math.cornell.edu/~hatcher/Top/TopNotes.pdf
- Lynn Arthur Steen and J. Arthur Seebach Jr., *Counterexamples in Topology*, 2nd Edition (1995), Dover Publications, ISBN-13: 9780486687353
- John H. Kelley, *General Topology* (Dover Books on Mathematics) Reprint Edition (2016), Dover Publications, ISBN-13: 9780486815442
- N. Bourbaki, *Topologie générale: Chapitres 1 à 4*, Springer 2006 Edition (1971), Springer, ISBN-13: 9783540339366

Prerequisites: A solid coursework on set theory (7412027). The instructor will assume that you have a sufficient knowledge and techniques on set-theoretic results and will not go into details. You should be able to fill in details. The instructor does not dissuade students without meeting the prerequisite criteria registering for this course at his/her own risk.

Course description: This is the first-semester course of a year-long course "General Topology" consisting of General Topology I (7412016) and General Topology II (7412023). Topology is a relatively new but huge area in mathematics consisting of point-set (or general) topology, algebraic topology, geometric topology, and differential topology, which has been a home for many fancy mathematics during the past century. For example, Smale's and Freedman's, and Perelman's theorems on Poincaré's conjecture, Mirzakani's volume of moduli spaces, Kontsevich's deformation quantization problem, Thurston's geometrization theorem, Donaldson's theory of 4-manifolds, Quillen's algebraic K-theory, Atiyah and Singer's index theorem, Thom's cobordism theory, Milnor's smooth structures on a 7-sphere, $\cdots$.

In this course, we shall specialize and study the earliest form of topology developed around the late 1800's and early 1900's, which is the time of a Soviet (Ukrainian) mathematician Pavel Samuilovich Urysohn. Some people might scare you off about this subject, but the idea is very simple – topology is an abstraction of the concept of distance. It lets you endow a concept of nearness on an abstract set, whereas the source of our intuition is always $\mathbb{R}^n$ which you are familiar with from your previous coursework. There are two possible cases of things getting trickier: (1) when you have to deal with a counter-intuitive concept of nearness introduced on a set or (2) when you have to give precise proof without mastering skills.

Perhaps this subject has the biggest discrepancies between a mastery of materials from textbooks and a fine preparation for the National Exam. So we are taking a strategy to cover necessary concepts and examples quickly and practice with problems from the National Exam and their variants. In this semester, we begin with the topology of real lines and learn topological spaces and continuous functions, metric spaces, countability, and separation axioms including Urysohn's lemma and metrization theorems. If time permits, we shall also cover compactness.

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

- Understand topological spaces and continuous functions.
- Understand metric spaces and apply the generality of topological spaces to metric spaces.
- Explain what are first and second countable spaces and give examples.
- Explain what are T_n-spaces with $n = 1, 2, 3, 3\frac{1}{2}, 4$.
- State and prove Urysohn's lemma and metrization theorem.
- Understand compactness and sequential compactness.
- Give appropriate examples to give a topological argument.
- Learn how to give a precise mathematical proof

- Create an online learning contents such as YouTube videos for sharing knowledge with a broader audience.
- Shape an overarching perspective on secondary school sets, functions, and calculus-related 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: 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: 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.

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.

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:

- Wednesday April 10th – National election day. Make-up date: TBA
- Wednesday May 15th – Buddha's birthday. Make-up date: TBA

Weekly lesson plan:

Week 1: Course introduction. Topology of the real line, Bolzano–Weierstrass theorem (Chapter 4)

Week 2: Topology of the real line: Heine-Borel theorem, Cauchy sequence and completeness, continuous functions, topology of the plane (Chapter 4)

Week 3: Topology of the plane (Chapter 4)

Week 4: Definition of a topological space, Accumulation points, closed sets, closure of a set, interior and boundary (Chapter 5)

Week 5: Neighborhoods, convergent sequences, coarser and finer topologies, subspace and relative topologies (Chapter 5)

Week 6: Base for a topology, subbases, local bases (Chapter 6)

Week 7: Continuous functions, sequential continuity, open and closed functions (Chapter 7)

Week 8: Leeway. Midterm exam (100-minute)

Week 9: Homeomorphic spaces and topological properties, topologies induced by functions, metrics, distance between sets, open spheres (Chapters 7, 8)

Week 10: Metric topologies and their properties, equivalent metrics, metrization theorems, isomorphic metric spaces, Euclidean m-space, Hilbert space, convergence and continuity in metric spaces, normed spaces (Chapter 8)

Week 11: First and second countable spaces, Lindelöf theorems, separable spaces, hereditary properties (Chapter 9)

Week 12: Separation axioms: T_1-spaces, Hausdorff spaces, regular spaces, normal spaces, completely regular spaces (Chapter 10)

Week 13: Urysohn's lemma and metrization theorems (Chapter 10)

Week 14: Compactness and finite intersection property, sequential compactness (Chapter 11)

Week 15: PBL presentations. 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 예의바르게 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, 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.