MATH 293-01, Mathematical Theory and Proof, Fall 2021
WF 1:00-1:50pm, Academic Center, 345

Instructor: Dr. Amy DeCelles

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Course Description: This course provides an introduction to mathematical discovery, conjecture, proof, and writing. The techniques covered are foundational to higher-level mathematics. Additional selected topics include: elementary number theory, relations, functions, and cardinality.

Course Co-requisite: MATH 131 (Calculus I) must be taken with a grade of C- or better.

Credits and Workload Expectations: 2 credits: 4 hours outside of class per week

Course Materials and Resources:

- *Mathematical Proofs*, 3rd Edition, by Gary Chartrand

Course Objectives: Upon successful completion of this course, students will be able to

- listen to and read mathematics with greater understanding and discernment, particularly in the context of following a mathematical line of thought (argument) (M1, ME1, M4, ME4);

- formulate and test mathematical hypotheses (M2);

- construct more clear, effective, and precise mathematical proofs (M2, M4, ME4);

- generally communicate mathematical ideas and information more clearly, effectively, and precisely through both oral and written means (M4, ME4); and

- exhibit proficiency in both conceptual understanding and computational techniques for the additional content outlined in the course description (M1, ME1).

Course Structure: This course is designed to help you progress from a basic to a deep understanding of the material. To prepare for class you will be assigned reading, along with a short reading reflection (R, due one hour before class) and discussion problems (D, due at the beginning of class). During class, I will briefly comment on the topic of the day, responding to questions raised in your reading reflections, clarifying points of confusion, and explaining certain concepts more fully. Then you will have time to work together on the discussion problems you have prepared, and I will coach you and give you feedback on those problems. About once a week, you will be assigned a mastery assignment, consisting of formal solutions to the discussion problems already covered in class and some additional problems.

Collaboration and Consultation: I encourage you, when working on homework, to collaborate with fellow students, to reread the textbook, and to ask the professor or the Learning Commons tutors for help. You are also free to consult other textbooks or online resources for general information on the topic. However, *you may not at any point consult any worked solution to an assigned homework problem.* If in doubt about the acceptability of a certain kind of collaboration or consultation, ask the professor. Please see the university policy on academic dishonesty, below.

Attendance: Attendance in class is expected, and a portion of the final grade comes from preparation for and participation in class. Absences for official university functions will be excused, provided that the instructor is notified in advance. Absences due to qualifying family or medical emergencies will also be excused, though the instructor reserves the right to ask for verification. In the case of an excused absence, it is the student's responsibility to contact the instructor in a timely fashion and, if desired, make arrangements for an assignment to compensate for the missed class work.

Late Work: Late work is typically not accepted. The lowest two scores in each per-class assignment category (R, D) and the lowest single mastery assignment score will be dropped at the end of the semester. (Effectively this allows each student to miss a typical week's worth of assignments with no grade penalty.) Extensions may be granted if requested before the due date, and work may certainly be submitted before the due date, if arrangements have been made with the professor in advance. If there is a serious, unforeseeable reason for missing more than two days of class, it is the student's responsibility to contact the professor as soon as possible and to make an appointment with the professor upon returning to classes to make a plan, e.g. whether to continue with the course, take an incomplete, or withdraw; and if continuing, how to make up missed work.

Missed Exams: Make-up midterm exams may be given to students with legitimate excuses such as serious illness, university sponsored events, etc., as long as the make-up exam can be taken within a reasonable time frame. If it is not possible to schedule a make-up exam within a reasonable time frame, the grade for the midterm may be prorated from the final exam. Written documentation may be required. Rescheduling the final is not possible except under very extreme circumstances.

Incompletes: Grades of I are normally not given in this course. However, they may be granted due to extenuating circumstances if (i) at least 60% of the course work has been completed at a level of C or better and (ii) the student demonstrates the ability to complete the remaining coursework outside of the classroom. In such cases, a well-documented petition should be submitted to the professor well before grades are due to the Registrar. Please see the university policies on incomplete grades and withdrawing from a class.

Final Course Grade: The overall score for this course will be computed as outlined below.

- Preparation and Participation (10%): reading questions (5%), discussion preparation and participation (5%)

- Mastery Assignments (30%): formally written solutions to the discussion problems and a few additional problems

- Exams (40%): midterm (Wed Oct 13), final (Mon Dec 6, 1-3p, in SCI 008), equally weighted

- Presentation (20%): oral presentation of a known proof of an interesting theorem

Final letter grades will be determined from the overall score as follows:

A	93-100	B+	87-89	B-	80-82	C	73-76	D+	67-69	D-	60-62
A-	90-92	B	83-86	C+	77-79	C-	70-72	D	63-66	F	0-59

Learning Commons: Located on the lower level of the Miller/Moore Academic Center (AC), the Learning Commons offers in-person and online tutoring services to all Bethel students, including help with any sort of writing projects, from conception to completion. Tutors are trained to give thoughtful feedback and advice on a variety of study skills, understanding concepts pertaining to relevant coursework, and overall writing concerns.

DEI: Bethel University respects the dignity of all God's image-bearers, and stands against racism, prejudice, and discrimination. Because Christ calls us to love our neighbor as ourselves, Christian discipleship includes pursuing the good of those who suffer injustice due to their color, race, or ethnicity. Therefore, we aim to continually transform our classrooms into safe and hospitable spaces where we listen to one another with mercy, learn from and value each other with tenacity, and commit to pursuing justice for the most vulnerable in our community.

Accessibility and Accommodations: Bethel University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, please contact the Center for Academic Success to discuss options. To schedule an appointment, email `rachel.kennedy@betheluniversity.edu` or call 574-807-7460.

Academic Dishonesty: The student handbook (p. 156) states: "Any act of deceit, falsehood or stealing by unethically copying or using someone else's work in an academic situation is strictly prohibited.

1. A student found guilty of plagiarism or cheating will receive an "F" (zero) for that particular paper, assignment or exam. Should this occur, the professor will have an interview with the student and will submit a written report of the incident to the academic dean.

2. If a second offense should occur, the student will be asked to appear before the professor, the academic dean and the vice president for student development.

The student should realize that at this point continuation in a course and even his/her academic career may be in jeopardy. In the event of a recommendation for dismissal, the matter shall be referred to the Student Development Committee."

Cell Phones: Cell phones must be turned off and stowed in book bags during class. Any student using a cell phone for any reason (without permission) will be asked to leave the class and an unexcused absence will be recorded. Students using cell phones during exams or graded activities may be cited for cheating (at professor's discretion). In the case of expected emergencies, students may seek permission from the professor to leave their cell phones on during class, but the phone must remain in the book bag. Professors reserve the right to have operational cell phones in class.

Covid-19: Students are expected to follow current Bethel University policies (e.g. re: masking); students not in compliance may be asked to leave the classroom and be recorded as absent.

Disclaimer: This syllabus is not a legal contract, but serves as a general outline for the semester. The professor reserves the right to announce in advance necessary adjustments to the course as the need arises.

Mon	Wed	Fri
Aug 16, 2021	Aug 18, 2021	Aug 20, 2021
		Intro (Ch 0, Preview 1.1)
Aug 23, 2021	Aug 25, 2021	Aug 27, 2021
	1.1-1.3 Sets and Set Operations (Preview 1.4) Due today: • R 1.1-1.3 (noon, on Canvas) • D #3, 6, 17, 20a, 26, 30 (at the beginning of class)	1.4 Collections of Sets, Arbitrary Unions and Intersections Due today: • R 1.4 • D #36, 40, 42
Aug 30, 2021	Sep 1, 2021	Sep 3, 2021
	1.5 Partitions Due today: • R 1.5 • D #46, 50 • M #3, 6, **9**, **12**, 17, **20**, 26, 30, **34** (add'l in bold)	1.6 Products of Sets Due today: • R 1.6 • D #57, 59, 63
Sep 6, 2021	Sep 8, 2021	Sep 10, 2021
Labor Day	2.1 Introduction to Mathematical Logic Due today: • R 2.1 • D (TBA)	2.2-3 Negation, Disjunction, and Conjunction Due today: • R 2.2-3 • D (TBA) • M #36, 40, 42, 46, 50, **52**, 57, 59, **60**, 63, **66**, **70**, **72**
Sep 13, 2021	Sep 15, 2021	Sep 17, 2021
	2.4-5 Implications Due today: • R 2.4-5 • D (TBA)	2.6 Implications (cont.) Due today: • R 2.6 • D (TBA) • M (TBA, 2.1-3)
Sep 20, 2021	Sep 22, 2021	Sep 24, 2021
	2.7 Tautologies and Contradictions Due today: • R 2.7 • D (TBA)	2.8-10 Logical Equivalence Due today: • R 2.8-10 • D (TBA) • M (TBA, 2.4-6)
Sep 27, 2021	Sep 29, 2021	Oct 1, 2021
	3.1-3 Intro to Proofs, Direct and Contrapositive Due today: • R 3.1-3 • D (TBA)	3.4-5 Proof by Cases; Evaluating Proofs Due today: • R 3.4-5 • D (TBA) • M (TBA, 2.7-2.10)
Oct 4, 2021	Oct 6, 2021	Oct 8, 2021
	4.1-2 Proofs Involving Integers Due today: • R 4.1-2 • D (TBA) • M (TBA, 3.1-3.5)	Fall Break

Mon	Wed	Fri
Oct 11, 2021	Oct 13, 2021	Oct 15, 2021
	Midterm Exam (Ch 1-3)	**4.3 Proofs Involving Real Numbers** Due today: • R 4.3 • D (TBA)
Oct 18, 2021	Oct 20, 2021	Oct 22, 2021
	4.4-5 Proofs Involving Sets Due today: • R 4.4-5 • D (TBA)	**4.6 Proofs Involving Products of Sets** Due today: • R 4.6 • D (TBA) • M (TBA, 4.1-3)
Oct 25, 2021	Oct 27, 2021	Oct 29, 2021
	5.1 Counterexamples Due today: • R 5.1 • D (TBA)	**5.2-3 Proof by Contradiction** Due today: • R 5.2-3 • D (TBA) • M (TBA, 4.4-6)
Nov 1, 2021	Nov 3, 2021	Nov 5, 2021
	5.4-5 Proving or Disproving Existence Statements Due today: • R 5.4-5 • D (TBA)	**Review Ch 4-5** Due today: • D (TBA) • M (TBA, 5.1-3)
Nov 8, 2021	Nov 10, 2021	Nov 12, 2021
	6.1-2 Mathematical Induction Due today: • R 6.1-2 • D (TBA)	**6.3 Counterexamples** Due today: • R 6.3 • D (TBA) • M (TBA, 5.4-5)
Nov 15, 2021	Nov 17, 2021	Nov 19, 2021
	6.4 Strong Induction Due today: • R 6.4 • D (TBA)	**7.1 Conjecture and Proof** Due today: • R 7.1 • D (TBA) • M (TBA, 6.1-3)
Nov 22, 2021	Nov 24, 2021	Nov 26, 2021
	Thanksgiving Break	Thanksgiving Break
Nov 29, 2021	Dec 1, 2021	Dec 3, 2021
	7.2-3 Revisiting Quantified Statements; Testing Statements Due today: • R 7.2-3 • D (TBA)	**Review Ch 6-7** Due today: • D (TBA) • M (TBA, 6.4-7.3)

Final Exam: Mon Dec 6, 1:00-3:00pm, SCI 008