Math 500.01W, Discrete Mathematics

CLASS SYLLABUS: Summer I, 2022

INSTRUCTOR INFORMATION

Instructor: Dr. Tingxiu Wang, Professor of Mathematics

Office Location:	Binnion 306	Office Hours: MWF 11:00am-12:00 pm on ZOOM, valid for entire Summer I: https://tamuc.zoom.us/j/96670434017
Office Phone:	903-886-5958	Office Fax: 903-886-5945
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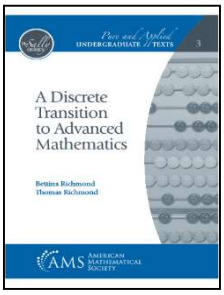
Preferred Form of Communication**: email**

Communication Response Time: usually within 24 hours during week days, M-F.

COURSE INFORMATION

This is an online class conducted on D2L Brightspace. Use the link https://leo.tamuc.edu, then, click the icon, D2L Brightspace for the class website. Please visit the class website to be familiar with it.

Course Materials:



- Required Technology: A computer with a webcam and stable internet access.
- Required Textbook: *A Discrete Transition to Advanced Mathematics* by Bettina Richmond and Thomas Richmond, ISBN-13: 978-0821847893 published by the American Mathematical Society, and can be purchased at http://bookstore.ams.org/amstext-3.
- A free student solutions manual can be downloaded from the link, http://www.ams.org/bookstore/pspdf/amstext-3-solutions.pdf
- Recommended for projects: *Discrete Mathematics in the Schools*, edited by J. Rosenstein, D. Franzblau, and F. Roberts, ISBN-13: 978-0-8218-1137-5. If you would like to work on a project (See Appendix C, Option 3) on discrete math for your classes that you teach, you may want to get this book. You can buy it at the following link, http://bookstore.ams.org/dimacs-36/.
- Required Articles: These are examples for your project.
  - Xing Yuan. Mathematical Fallacy Proofs, MIT student projects. Available MIT Open Courseware: http://dspace.mit.edu/bitstream/handle/1721.1/100853/18-304-spring-2006/contents/projects/fallacy_yuan.pdf
  - David and Elise Price. Complex Numbers: From "Impossibility" to Necessity. The AMATYC 2018 Conference Proceedings https://cdn.ymaws.com/amatyc.site-ym.com/resource/resmgr/2018_proceedings/s038_-_price.pdf
  - Sean Saunders, Standing on the Shoulders of Giants. The AMATYC 2019 Conference Proceedings. This is a Power Point Presentation, which gives you ideas what to do. When you write your project, you need to write it as a paper, not a PowerPoint Presentation. https://cdn.ymaws.com/amatyc.site-ym.com/resource/resmgr/2019_conference_proceedings/s017_saunders.pdf

Course Description: Study of formal logic; sets; functions and relations; principle of mathematical induction; recurrence relations; and introductions to elementary number theory; counting (basic combinatorics); asymptotic complexity of algorithms; graph theory; and NPcompleteness. Prerequisite: Consent of the instructor.

Student Learning Outcomes:

At the end of this course students will be able to

- Prove or solve selected problems in theories and applications of Combinatorics, Functions, Graph, Logic, Numbers, and Sets.
- Apply methods of proof in graduate math courses that study definitions and theories of mathematics. Examples of these courses include abstract algebra, topology, real analysis, and complex analysis.
- Analyze some mathematics mistakes made by college students and students of Grades 7-12.
- Develop some examples of discrete mathematics used in Grade 7-12 classes.

COURSE REQUIREMENTS

Evaluation is based on homework, tests, and a course project.

Attendance: Online attendance is required. It is critical that you keep up with the pace of this class. A summer term goes very quickly. Once you are behind our pace, you can get lost easily. You are strongly suggested to study ahead of our pace. Online attendance in this course is determined by your login and participation in our course on LMS (Learning Management System), D2L.

Attendance includes watching video lectures, joining online discussion, and submitting required homework timely.

Time for this course: Education is an investment. In addition to the tuition, a student invests the time for education. The time for study is essential for the success of your education or investment. How much time does one need for this class? A thumb of rules in education is three times of the credit hours per week in a regular semester. For example, if one takes 12 credit hours, the time for study is 36 hours, 12 x 3 = 36. This is why taking 12 credit hours is considered a fulltime student. For this course, you need to spend 9 hours per week in a regular semester. A summer term has five weeks. Therefore, one week in a summer term is equivalent to three weeks in a regular semester. So, you need to spend approximately 27 hours per week in a summer term, or five hours per day, Monday through Friday. Each day, you would need two hours to watch video lectures, and three hours for study and homework. If one has a weaker math background or rusty on the prerequisite, or wants to learn well for a better grade, more time is necessary.

Homework: No one can learn without practice, and no one can learn well without sufficient practice. Thus, homework must be done and submitted to show your study and attendance.

The total for homework is 120 points (24 points for Ch.1, 22 for Ch. 2, 22 for Ch.3, 14 for Ch. 4, 18 for Ch. 5, 12 for Ch. 6 and 8 for Ch.7.) Homework assignments are listed in Appendix A. After you watch each video lecture, do the corresponding homework assignments. Homework will be graded based completion, instead of correctness. They will be checked for how many questions are completed and if necessary work is presented. Missing questions and answers without work do not earn credit. Late submission will be subject to a deduction of 1/3 of the points for that chapter.

You may work and discuss homework together on D2L. To do so, click Activities, Discussions for each week on D2L. You can share your homework there. When you share your homework in Discussion on D2L, everyone can see it and download it.

Please submit your homework to D2L, Activities, Assignments with the file name format: YourLastName-HW-Ch#. Deadlines for homework assignments can be found in Appendices A and B, as well as on D2L. The assignment you submit must be your own work. Plagiarism is prohibited. The instructor will post some graded homework assignments on D2L. The textbook has answer keys and solutions for some homework assignments. You can also use the solution manual of the textbook at http://www.ams.org/bookstore/pspdf/amstext-3-solutions.pdf. Feel free to ask your instructor questions during office hours on ZOOM.

Tests: There will be three tests. Each test is worth of 100 points for 90 minutes. Please see Appendix B for the dates and times of tests, as well as at the end of this paragraph and D2L. Please verify immediately if these dates and times are feasible for you. Instead of using online proctoring service or a testing center, we use ZOOM to proctor tests. In this way, we save money for our students. So you must have a webcam on your computer. When we have a test, a ZOOM link will be provided. Submit your test to D2L with the following file name: YourLastName-Test#. For taking a test, you should log on ZOOM to check in at 2:45 PM. Each test will start at 3:00 PM promptly. The test will be closed at 4:30 PM, and you need to complete submission of your test by 4:45 PM. Tests will not be accepted after 4:45 PM. So for the entire test, you need to be available for two hours from 2:45 PM to 4:45 PM.

- Test 1: 3:00 PM – 4:30 PM, Wednesday, June 15
- Test 2: 3:00 PM – 4:30 PM, Thursday, June 23
- Test 3: 3:00 PM – 4:30 PM, Tuesday, July 5

Please confirm the testing time. If it does not work for you, please give a time so that we will ask the entire class.

Project: You will do a course project, worth of 100 points. Please see details in Appendix C. The deadline for submitting your project is 11:59PM, Thursday, July 8, 2021. Submit your project to D2L, Activities, Assignments, with the following file name: YourLastName-Project.

Grading: The maximum possible points available in this course are:

Homework	120 points
Tests	300 points
Projects	100 points
Total	520 points

Your course grade will be based on the percentage of the points you make to the total points available in the course:

A >= 90%, B >= 80%, C >= 70% D >= 60% F < 60%.

TECHNOLOGY REQUIREMENTS

- TI-83/84 or other calculators with similar capability is highly recommended.
- Scanner/digital camera/cell phone that you can make PDF files of your work and submit them to D2L. Make one PDF file for each test, project, for each chapter, and homework for each chapter. Please visit the following video clips for making one PDF file:
  - Using CamScanner: https://www.youtube.com/watch?v=sZFcQJCmtMI
  - Android: https://www.youtube.com/watch?v=FWlVYd2Zc-E
  - iPhone: https://www.youtube.com/watch?v=10XH6VfGLqI

- D2L/LMS: All course sections offered by Texas A&M University-Commerce have a corresponding course shell in the myLeo Online Learning Management System (LMS). You will obtain the course materials through D2L. You cannot distribute the course materials without permission of the instructor. To access D2L, go to myLeo, then Apps, then My Leo Online D2L Brightspace. You also have an email account via myLeo - all my emails sent from D2L (and all other university emails) will go to this account, so please be sure to check it regularly.

Below are technical requirements

- LMS Requirements: https://community.brightspace.com/s/article/Brightspace-Platform-Requirements
- LMS Browser Support: https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm
- YouSeeU Virtual Classroom Requirements: https://support.youseeu.com/hc/en-us/articles/115007031107-Basic-System-Requirements

ACCESS AND NAVIGATION

You need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@tamuc.edu**.**

Course readings, assignments and discussions will be completed /turned in through LMS. Your grades will be available in D2L. The course materials are only for this course. You cannot distribute the course materials without permission of the instructor

This course is presented using weekly units. Each unit contains video lectures, a discussion area, assignments, a quiz or an exam.

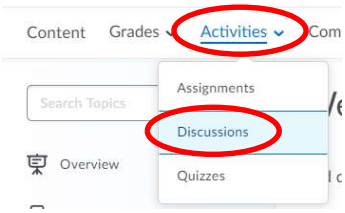
You should begin by reading the course syllabus, paying particular attention to the assignments and Suggested Day-by-Day Schedule, and then complete the Start Here unit.

Note: Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a TAMUC campus open computer lab, etc.

COMMUNICATION AND SUPPORT

Interaction with Instructor: You may email and telephone your instructor, and visit your instructor during his office hours at ZOOM. I will try to respond your email within 24 hours, Monday through Friday. My response over the weekend may have a delay.

The following features are available through Activities, Discussions:



- **Discussion**: This space is for student questions and discussions related to the week's content. Please feel free to answer one another's questions. I will check answers (as well as questions) for correctness. Feel free to respond to a posting if you feel you can answer the question thoroughly and directly.
- **Sharing your homework with the class**: We do not grade your homework. To help your study, you can share your homework with the class by posting your homework in Discussion. Make sure you do homework independently. When you post your paper for a homework assignment on D2L, please use a title like, Assignment 1 on Pages 8-9, #3, 4, 9. When you correct mistakes and

errors for a shared assignment, use a description like, “Correction on #3 of Assignment N (or Page #), posted by XYZ (name of the student).”

Math Lab: Free tutoring service offered by the Mathematics department (Binnion Hall Room 328). Please visit the web site for the hours of operation and more details.
http://www.tamuc.edu/academics/colleges/scienceEngineeringAgriculture/departments/mathematics/mathlab/default.aspx

For student resources, visit https://new.tamuc.edu/admissions/resources/.

The TAMUC Academic Success Center provides academic resources to help you achieve academic success. http://www.tamuc.edu/admissions/onestopshop/registrationAndAcademicRecords/default.aspx

Technical Support If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778. Other support options can be found here: https://www.tamuc.edu/facultyStaffServices/academictechnology/

Syllabus Change Policy

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

University Specific Procedures

Student Conduct

- All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the Student Guidebook.
  http://www.tamuc.edu/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx
- Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum: https://www.britannica.com/topic/netiquette

TAMUC Attendance

- For more information about the attendance policy please visit the Attendance webpage and Procedure 13.99.99.R0.01. http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx
- http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/academic/13.99.99.R0.01.pdf

Academic Integrity

Students at Texas A&M University-Commerce are expected to maintain high standards of integrity and honesty in all of their scholastic work. For more details and the definition of academic dishonesty see the following procedures:

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/undergraduates/13.99.99.R0.03UndergraduateAcademicDishonesty.pdf

Graduate Student Academic Dishonesty 13.99.99.R0.10

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/graduate/13.99.99.R0.10GraduateStudentAcademicDishonesty.pdf

Students with Disabilities-- ADA Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services

Gee Library- Room 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu
Website: Office of Student Disability Resources and Services
http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/

Nondiscrimination Notice

Texas A&M University-Commerce will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

Campus Concealed Carry Statement

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the Carrying Concealed Handguns On Campus document and/or consult your event organizer.

Web url:
http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

Appendix A: Homework Assignments

Tip: Each homework assignment corresponds to a video lecture. After watching each video lecture, do the corresponding homework. A few video lectures do not have a homework assignment. Then watch two video lectures before doing the homework, like Assignment 1&2, 14&15, and 22&23.

Assignment and Lecture #	Problems	
Chapter One		
1&2	Page 7-8, #3, 4, 9	**Homework for Ch. 1 due Friday, June 10, 11:59PM**
3	Pages 18-20. #2, 3, 4, 10	
4	Pages 19-20, #6	
5	Use Venn diagrams to show that (1) $A \cap (B \cup C)$ (2) DeMorgan's Law: $(A \cap B)^c = A^c \cup B^c$	
6	Pages 20, #12, 13, 14, 16	
7	Pages 23, Justify your answers, #2, 4, 7(a, b, c)	
8&9	Pages 32-34, #1, 2, 3, 5	
10	Pages 33-34, 6, 7, 8, 9, 13	
11	Pages 38-39, #1, 2, 3	
12	Pages 47, #7, 10,(iv, v, vii), 11(a, c)	
13	Pages 46-47, 1, 2, 5, 6(b, c, d, g), 8(a)	
Chapter Two		
14&15	Prove that (1) The sum of any two odd integers is an even integer (2) The sum of an even integer and an odd integer is an odd integer (3) The product of an even integer and an odd integer is an even integer (4) The product of two even integers is an even integer	**Homework for Ch. 2 due Tues., June 14, 11:59PM.** **Test 1 covers Chapters 1&2, at 3:00 PM, Wed., June 15. Review questions for Test taken from the homework are posted on D2L.**
16	Page 59, #8, and (1) Prove that |xy|=|x||y|	
17	Prove or disprove (1) $(x+1)^3 \geq x^3, \forall x \in R$ (2) If p is a prime number, so is p^2.	
18	Pages 59, #13, 14, 16, and (1) Prove that if x^2 is irrational, so is x. (2) Prove that the product of a rational number and an irrational number is an irrational number.	
19	Page 60, #20, 22, 23	
20	Page 59, #6, 9, 10, 11, 29	
21	Page 68, 2(b, d), 9, 11	
22&23	Page 75-76, 1, 2, 3, 4, 6, 8	
24	Page 75-76, 7, 9, 10, 11	
Chapter Three		
25	a. Get answers for Fact 2 and Fact 3. b. How many integers are there such that (i) $-12 \leq i \leq 36$ (ii) $-33 \leq i \leq -14$ (iii) Between -10^{30} and 10^{30}	**Homework for Ch. 3 due Mon., June 20, 11:59PM**

26	a. Find the values of each of the following (i) $\left\lfloor \frac{16}{47} \right\rfloor$ (ii) $\lfloor -167 \rfloor$ (iii) $\lfloor 278 \rfloor$ (iv) $\lfloor -7.32 \rfloor$ (v) $\lfloor -0.5 \rfloor$ b. Find the values of each of the following (i) $\left\lceil \frac{16}{47} \right\rceil$ (ii) $\lceil -167 \rceil$ (iii) $\lceil 278 \rceil$ (iv) $\lceil -7.32 \rceil$ (v) $\lceil -0.5 \rceil$ c. How many odd integers are there between (i) 1 and 30 (ii) 41 and 120 (iii) 31 and 97 (iv) 100 and 10000 d. How many multiples of 6 are there between (i) 0 and 120 (ii) 9 and 77 (iii) -8 and 34 (iv) -300 and 4300	
27	Page 86, 2, 3, 4, 5	
28	Page 87, 9, 17(b, c), 19, 20, 21 Hint for #19, 20, 21: proof by mathematical induction, or by cases. See Lectures 16 and 21.	
29	Page 86, 7(a, b, c, d), 13, 10	
30	Page 87, 15 (Find $\gcd(m,n)$ by two methods)	
31	Page 94, 1(b, d), 4, 7, 9 A. There are three methods to find $\gcd(m,n)$. Which one do you like better? Please explain	
32	Page 100, 1(b, d), 5, 6, 13	
33	Page 108, 6(a, Hint: by mathematical induction), 14(b)	
Chapter Four: We rearrange the topics in Sections 4.1, 4.2 and 4.3 in terms of the order of concept development: the Fundamental Principle of Counting, Permutations, and Combinations. Watch video lectures first, then read the textbook for related topics as indicated in the following assignments.		
34	Read: Pages 132-136 (stop at Example 4.2.4. Do not read 4.2.4) HW, Pages 139-140, 1, 7, 8(a)	**Homework for Ch. 4 due Thurs., June 23, 11:59PM.** **Test 2 covers Chapters 3&4, at 3:00 PM, Thurs., June 23. Review questions for Test taken from the homework are posted on D2L.**
35	Read: Pages 136 (Example 4.2.7)-139. Homework assignments: a. Find P(24, 3), P(14, 7), P(8, 7) b. In how many ways, can a 12-member committee choose a chairperson, vice-chairperson and a secretary? c. How many permutations can we get with digits 1, 2, 3? List all of them. d. How many permutations can we get with A, B, C, D?	
36	Read: a. Pages 136-137 in the order, Example 4.2.6, 4.2.5, then 4.2.4. b. Read Page 128 Definition 4.1.7, then Page 142 Theorem 4.3.2. c. Read Examples 4.1.3, 4.1.4, 4.1.5, 4.1.6 and the following paragraph. HW, Page 131, #1, 2, 3, 4, 5; Page 145, #1(a, c, d, h), 2	
37	Read: Page 129, from Theorem 4.1.8 to (including) Figure 4.7. Then 4.1.9. If you like you may read Pages 123-127. HW, Page 132, #7, Page 145, #3(a, b, c), 4	
38	Read: Section 3. HW, Page 140, #5, 8(b, 8a was assigned in Assignment 34), Page 146 #8 a. Five cards are selected from a standard deck of 52 cards. In how many ways can you get four-of-a-kind? Four-of-a-kind consists of four cards of the same denomination and one other card. For example, A-A-A-A-8 and 7-7-7-7-K are hands of four-of-a-kind.	

39	Read: pages 147-149 up to Example 4.4.4 (inclusive) HW, Page153, #1(b, d, f), 5, 8	
40	Read: Pages 149-152, up to Example 4.4.9 (inclusive) HW, Page 154, #3, 7, 11, 13, 15	
41	Read Section 4.5 a. Find the sample space, S, and |S| (i) Two card are selected from the red cards of a standard deck of 52 cards (ii) A student must answer three questions from a set of four questions	
42	Read Section 4.5 Pages 160-161, #2, 4, 6(a, c) a. The employees of a company are in the following departments: 31 in Sales, 54 in Research, 42 in Marketing, 20 in Engineering, 47 in Finance, and 58 in Production. If an employee's paycheck is lost, what is the probability that the employee is in the Research Department? b. A shipment of 12 microwave ovens contains three defective units. A vending company has ordered four of these units, and since each is identically packed, the selection will be at random. What is the probability that (i) all four units are good, (ii) exactly two units are good, and (iii) at least two units are good?	
Chapter 5		
43	Read Pages 163-165 Page 168, #1, 2, 8(a)	
44	Read Pages 166-168 Pages 168-170, #5(b, d), 6(a, d), 7, 8(b), 9	
45	1. Let S be a set of marbles with different colors and sizes. Define a relation between marbles by $s \sim t$ if s and t have the same size. Is $\sim$ an equivalence relation? Please explain. Let [s]={t| $t \in S$, $t \sim s$ }. What does [s] look like? 2. Let A={1, 2, 3, 4, 5, 6}. Define a relation on A by $m \sim n$ if $m-n$ is an even integer. Is $\sim$ an equivalence relation? Please explain. Let [m]={t| $t \in A$, $t \sim m$ }. Find all [m]. 3. Let $A = \{n \in \mathbb{N} : n^2 < 36\}$ and R be a relation on A defined by $$R = \{(m,n) : m \equiv n \pmod 3\}$$ a. List all numbers in A. b. List all points in R. c. Specify which of the properties (R), (T), (S), (AS), and (AR) the relation satisfies. Is *R* an equivalence relation? If yes, let [m]={t| $t \in A$, $t \sim m$ }, and find all [m]. 4. Let $S = \{1,2,3,4\}$ and R be a relation from S to S defined by $R = \{(m,n) : m+n \in S\}$. Do the same problems listed in #3.	**Homework for Ch. 5 due Tues., June 28, 11:59PM**
46	Read Pages 174-175 (before 5.2.7). You may leave reading after Lecture 48. Page 177, #3(a, b) 1. Let $f(n) = \cos\frac{n\pi}{2}, n \in \mathbb{N}$. A relation on $\mathbb{N}$ is defined as $m \sim n$ if and only if $f(m) = f(n), \forall m, n \in \mathbb{N}$ .Prove that $\sim$ is an equivalence relation. Then find all equivalence classes.	
47	Read Pages 171-173 1. It is 2:00 PM now. Use congruence modulo 12 to determine what time it is after a. 9 hours; b. 17 hours; c. 28 hours; d. 17 hours. 2. Given a positive integer, p, prove that $m \equiv n$ (mod p) is an equivalence relation. 3. Find all congruence classes modulo 6, $[n]_6$.	
48	Read Pages 174-175 (before 5.2.7)	

	Page 177, #5, 6	
49	List numbers in $Z(6)$ and $[n]_6, n \in \mathbb{Z}$. Complete the $+_6$ and $*_6$ tables in $Z(6)$: $+_6$ | 0 | 1 | 2 | 3 | 4 | 5 0 | | | | | | | 1 | | | | | | | 2 | | | | | | | 3 | | | | | | | 4 | | | | | | | 5 | | | | | | | $*_6$ | 0 | 1 | 2 | 3 | 4 | 5 0 | | | | | | | 1 | | | | | | | 2 | | | | | | | 3 | | | | | | | 4 | | | | | | | 5 | | | | | | | 1. Find the additive identity and multiplicative identity of $Z(6)$. 2. Find the additive inverse of each element of $Z(6)$. 3. Find the multiplicative inverse of each element of $Z(6)$. 4. Find a. $2 +_6 5$; b. $2 *_6 5$ 5. Find x in $Z(6)$:a. $2 +_6 x = 0$; b. $2 +_6 x = 3$; c. $3 +_6 x = 2$ 6. Find x in $Z(6)$:a. $2 *_6 x = 0$	
50	Read Pages 188-190 (before Quasiorder). 1. It is September now. What is the month after 40 months? Use the modular arithmetic notation to show your work. 2. It is Thursday now. What is the day after 136 days? Use the modular arithmetic notation to show your work. 3. Let $m, m', n, n' \in \mathbb{Z}$, and p a positive integer. Prove that if $m' \equiv m (\mathrm{mod}\ p)$ and $n' \equiv n (\mathrm{mod}\ p)$, then $m' \cdot n' \equiv m \cdot n (\mathrm{mod}\ p)$. Page 195, #7	
Chapter 6 and Chapter 7		
51/52	There are many terms in Lectures 51/52. Review and write them. Determine if the following cases are functions. Then determine the domain, codomain and range. 1. $f : \{1,2,3,4\} \to \{1,2,3,4\}$ defined by $\{(1,1),(2,2),(3,3),(4,4),(1,2)\}$. 2. $g : \{1,2,3,4\} \to \{1,2,3,4\}$ defined by $\{(1,1),(2,2),(3,3)\}$. 3. $h : R \to R$ defined by $h(x) = \sqrt{x}$. 4. $h : [0,\infty) \to R$ defined by $h(x) = \sqrt{x}$.	**Homework for Ch. 6&7 due Sunday, July 3, 11:59PM.** **Test 3 covers Chapters 5, 6&7, at 3:00 PM, Tues., July 5. Review questions for Test taken from the homework are posted on D2L.**
53	Page 204-205: 2, 3, 4, 5	
54	1. Suppose functions $f : \{1,2,3\} \to \{1,2,3\}$, $g : \{1,2,3\} \to \{1,2,3\}$ are given as: $f = \{(1,2),(2,1),(3,1)\}$, $g = \{(1,1),(2,3),(3,3)\}$. Find: a. $g \circ f$, b. $f \circ g$, c. $(f \circ g) \circ f$. d. The domains and ranges of these functions 2. For $f(x) = \frac{3x}{2-x}$, and $g(x) = \frac{x}{1+x}$, find a. $g \circ f$ b. $f \circ g$ c. the domain and range for $g \circ f$ and $f \circ g$.	
55	Page 213: 3(a, b, c), 1. Given a relation $R : \{1,2,3\} \to \{1,2,3,4\}$ defined by $R = \{(1,2),(2,1),(2,3),(3,4)\}$. a. Is R a function? b. Find the inverse relation, R^{-1}. Is R^{-1} a function? If R^{-1} is a function, find its domain and range.	
56	Page 214: 5, 6(a, b, c, d)	

57&58

1. For the given digraph, E(G)={a, b, c, d, e, f, g} and V(G)={w, x, y, z}. Give a table of the function, γ .

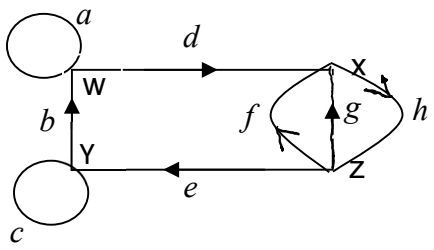


Figure 1

2. Which of the following vertex sequences describe paths in the digraph, Figure 1?
   a. wxzx b. zxwyy c. wyxx d.wwxzx

3. Which paths are closed paths?
4. Is Figure 1 an acyclic?
5. For Figure 1, give an example of each of the following. Be sure to specify the edge sequence and the vertex sequence.
   a. A path of length 2 from w to x
   b. A path of length 2 from y to y
   c. A path of length 3 from w to z
   d. A path of length 4 from y to y
   e. A path of length 5 from y to y

6. Draw of picture of the digraph G with vertices $V(G)=\{w,x,y,z\}$ and edges $E(G)=\{a,b,c,d,e,f\}$ and $\gamma: E(G)\to V(G)\times V(G)$ given by the following table:

e	a	b	c	d	e	f	g	h
$\gamma(e)$	(w, z)	(z, z)	(w, x)	(y, w)	(z, y)	(x, z)	(z, x)	(y, x)

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1. Given $A=\begin{bmatrix}-1 & -2 & 3\\ 2 & 4 & 1\end{bmatrix}$, and $B=\begin{bmatrix}2 & 3\\ -3 & 2\\ 1 & -1\end{bmatrix}$ Find

a. A-B b. A-2B^T c. BA d. AB e. AB^T

2. Identify elements of c_{31}, c_{13}, c_{22}, c_{12} of matrices you found in Question 1.
3. Let A and B be two matrices. Is AB=BA? Give a counter example.

60

1. give the adjacency matrix for the diagraph, Figure 1 in #1 of Homework 57/58.

2. Draw a diagraph for the following matrix: $\begin{bmatrix}0 & 0 & 1 & 2\\ 0 & 1 & 0 & 1\\ 1 & 0 & 1 & 0\\ 2 & 1 & 0 & 0\end{bmatrix}$

Appendix B: Suggested Day-by-Day Schedule

This schedule gives you an idea how much you need to learn each day. You may study ahead of this schedule, but do not fall behind because it will be difficult to catch up once you get behind. We may modify this Schedule if necessary. The deadline of each homework assignment is also listed on Appendix A, Homework Assignments.

Week of	Monday	Tuesday	Wednesday	Thursday	Friday	
June 6 Week 1	• Read Syllabus • Be familiar with D2L • Get the course materials Section 1.1 1. Sets 2. Venn Diagrams Section 1.2 3. Set operations 4. Laws of algebra of sets	Section 1.2 5. Proofs involving sets 6. Tree diagrams and Cartesian coordinates Section 1.3 7. Partitions Section 1.4 8. Introduction to logic 9. Logic operations	Section 1.4 10. Tautology Section 1.5 11. Quantifiers Section 1.6 12. Implications 13. Implications2	Section 2.1 14. Proof techniques 1 15. Proof techniques 2 16. Proof techniques 3 17. Proof techniques 4	Section 2.1 18. Proof techniques 5 19. Proof techniques 6 20. Proof techniques 7 **Homework for Ch. 1 due Friday, June 10, 11:59PM**	
June 13 Week 2	Section 2.2 21. Math Induction Section 2.3 22. Pigeonhole principle 1 23. Pigeonhole principle 2	Section 2.3 24. Pigeonhole principle 3 Review for Test 1 **Homework for Ch. 2 due Tues., June 14, 11:59PM**	**Test 1: covers Ch. 1&2** Section 3.1 25. Number Theory: Intro.	Section 3.1 26. Number theory: floor and ceiling functions 27. Divisibility (1) 28. Divisibility (2)	Section 3.1 29. Prime numbers 30. Relative primes Section 3.2 31. Euclidean Algorithm	
June 20 Week 3	Section 3.3 32. Least Common Multiple Section 3.4 33. Divisibility tests Section 4.2/4.4 34. Fundamental principle of counting **Homework for Ch. 3 due Mon., June 20, 11:59PM**	Section 4.2/4.4 35. Permutations Section 4.1/4.3 36. Combination 1 37. Combination 2	Section 4.1&4.3 38. Combination 3 Section 4.4 39. Combinatorics 1 40. Combinatorics 2 Section 4.5 41. Probability 1 42. Probability 2	Review for Test 2 **Homework for Ch. 4 due Thurs., June 23, 11:59PM** **Test 2: covers Ch. 3&4**	Section 5.1 43. Relations (1) 44. Relations (2) Section 5.2 45. Equivalence relations	
June 27 Week 4	Section 5.2 46. Equivalence Classes 47. Congruence Modulo p (1) 48. Congruence Modulo p (2)	Section 5.2 49. Modular Arithmetic (1) 50. Modular Arithmetic (2) Section 6.1 51. Functions (1) 52. Functions (2) **Homework Ch. 5 due Tues, June 28, 11:59PM**	Section 6.1&6.2 53. Functions (3) 54. Functions (4)	Sections 6.1, 6.2 55. Inverse functions (1) 56. Inverse functions (2) Start working on Project	Section 71&7.2 57. Graph theory 58. Digraph and graph 59. Matrices 60. Adjacency matrices Review for Test 3 Project	**Test 3: covers Chapters 5, 6&7**. **Homework Ch. 6&7 due Sunday, July 3, 11:59PM**
July 4 Week 5	Independence Day	Test 3 Project	Project	**Project due by 11:59pm July 7** **Complete online evaluation Summer I is over**		

Appendix C

A Project of Discrete Mathematics

You will need to do a project on discrete mathematics. Start your project as soon as possible. Your project must be submitted electronically in the Microsoft Word file by 11:59PM, Thursday, July 7, 2022 to your instructor. Your project will be evaluated based the following rubrics.

1. Excluding the title and reference pages, your paper must have at least 10 pages with double line space. Each missing page will result in a deduction of 15 points in addition to the deductions based on the following rubrics.
2. (5 points) Professional appearance and format of your paper: The margins are not more than 1" from each side; the font size should not be larger than 12; and the font can be Calibri, or Times New Roman. The paper must be numbered. The sizes of tables and pictures need to be reasonable. Your paper should be organized in the following format:
    a. Project title, names of authors, emails and affiliations (optional)
    b. Project summary, abstract, and/or objectives
    c. Project Body (you may use sections, bullets tables, pictures)
    d. Acknowledgement (if applicable)
    e. References: If you obtained any information from the Internet, include the URL. You need use the MLA (Modern Language Association) citation style, or the Chicago citation style, or the style of a reputable mathematical journal, for example, the Journal of Mathematical Analysis and Applications (http://www.elsevier.com/wps/find/journaldescription.cws_home/622886?generatepdf=true)

    Your paper must be presentable, or the entire project will receive 0 points.

3. (5 points) Summary or abstract of your project. You may include objective statements.
    a. Project title, names of authors, emails, affiliations, abstract should be included in the title page.

4. (15 points) Difficulty and complexity: There are four options for your project (see the next page). For Project Option 1 and 2, the difficulty refers to the level of school mathematics from the lowest, arithmetic, to the highest, calculus II. For Project Option 3, your project needs to be at least at the level you taught, teach, or will teach. The appropriate length of the project is also a consideration of difficulty, though the minimum length is 10 pages with double space. An unnecessarily lengthy paper will not be considered more difficult. Difficulty may mean complexity. Use and inclusion of definitions, theorems and proofs will reflect difficulty and complexity. The more difficult the mathematics is, the more points you may earn.

5. (15 points) Originality or creativity: The first meaning of originality is that your paper must be your own work. Plagiarism is prohibited, and hence will result in 0 for the entire project. Any materials taken from the Internet, publications and other people's work must be well cited. The second meaning of originality is that your work has not been seen on the Internet and in publications. Originality may also mean creativity. The more original work your project has, the more points you may earn.

6. (60 points) Readability and Communication: clear and correct calculation, derivation, proofs, applications and explanation; sufficient and appropriate examples; real world examples, particularly related to your students, school and community (this also contributes to originality); smooth connection and transition among concepts, definitions, theorems, examples, and explanations; use of pictures, diagrams, and tables; easiness for understanding; appropriate citation; completeness of the project; fun to read.

7. Correctness: mathematically your project must be correct. Errors and mistakes in mathematics will be subject to deduction of points you earn. Errors and mistakes in other areas (English, Education, Science…) may or may not cause a deduction, depending on the nature and significance of the errors and mistakes.

8. The instructor retains the final interpretation of the grading rubrics.

You can choose one of the following topics for your project:

Option 1, False Proofs: There are many false proofs. For example, the following article is an MIT student project:

- Xing Yuan, Mathematical Fallacy Proofs http://dspace.mit.edu/bitstream/handle/1721.1/100853/18-304-spring-2006/contents/projects/fallacy_yuan.pdf

You also see two other examples in our lecture, Proof Techniques (1), Introduction.

For this project, you need to search the Internet for more new false proofs. Do not use the examples from our lectures and Yuan's paper. For each false proof you use, please explain what lead to the false proof, and how the false proof helps students learn and understand and/or enhance your teaching.

Option 2, Analysis and Classification of Student mistakes and difficulties: Students often have difficulties and make mistakes in arithmetic, algebra, trigonometry, and calculus. Why? What kind of mistakes and difficulties do they make or have? How can you help? You may read the following articles from the following link:
https://www.semanticscholar.org/paper/Exploring-%E2%80%98Non-Science%E2%80%99-Grade-11-Learners%E2%80%99-Errors-Makonye-Nhlanhla/b84228d28657154d01b0c8b4e7b1f02764d96da0

- Judah Paul Makonye and Sibanyoni Nhlanhla. Exploring 'Non-Science' Grade 11 Learners' Errors in Solving Quadratic Equations, Mediterranean journal of social sciences, Page 634, Vol. 5, 2014
- Jane Tendere. An Analysis of Errors and Misconceptions in the Study of Quadratic Equations, European Journal of Science and Mathematics Education, pp. 81-90, Vol. 1, 2020.

If you have taught or tutored before, you may collect the mistakes that your students made, then classify and analyze them. You may also develop a plan how you would apply your findings in your classroom.

Option 3, Discrete Mathematics in Your Classroom. If you are a pre-service or in-service teacher, you may choose to read the three articles in Section 4 (Pages 187-202, Pages 203-222, and Pages 223-236) and the four in Section 5 (pages 239-254, Pages 255-264, Pages 295-300, and Pages 301-307) in the following book,

- *Discrete Mathematics in the Schools*, edited by J. Rosenstein, D. Franzblau, and F. Roberts , published by the American Mathematical Society, ISBN-13: 978-0-8218-1137-5, http://bookstore.ams.org/dimacs-36/.

You may also read other articles in the book if you like. After your reading, develop a teaching plan how you can include some topics of discrete mathematics in your classroom.

Or, you may pick a section (or a topic) in the textbook. Develop a lecture note how you would teach it. Your lecture note should include introduction (your understanding of the section(s)), definitions, theorems, examples, and your explanation of the definitions, theorems, applications if there are applications, and homework assignments. Have a description why the section or topic is important.

Option 4: Any other topics of discrete mathematics that you would like to investigate further. Discuss this with your instructor before you work on it. See the following examples:

- David and Elise Price. Complex Numbers: From "Impossibility" to Necessity. The AMATYC 2018 Conference Proceedings https://cdn.ymaws.com/amatyc.site-ym.com/resource/resmgr/2018_proceedings/s038_-_price.pdf
- Sean Saunders, Standing on the Shoulders of Giants. The AMATYC 2019 Conference Proceedings. This is a Power Point Presentation, which gives you ideas what to do. When you write your project, you need to write it as a paper, not a PowerPoint Presentation. https://cdn.ymaws.com/amatyc.site-ym.com/resource/resmgr/2019_conference_proceedings/s017_saunders.pdf