

Welcome to MATH 2305 – Discrete Mathematics

Semester Syllabus

Delete these instructions after following them: Instructors must make the following customizations:

- Change all highlighted text and remove highlights. Text highlighted in yellow should be customized; text highlighted in green is instructions that should be followed and then deleted.
- It is impossible to arrange the vertical spacing correctly on the master syllabus, as each instructor will be adding and deleting items. Consider starting each of the Level 1 Headings (The Basics, Course Calendar, Getting Help, Grades, Course Content, and The Details) at the top of a new page.
- In order to make the document accessible to screen readers, the master syllabus uses styles for text. The 6 styles in use are Title, Subtitle, Heading 1, Heading 2, Normal, and [hyperlink](#). If you would like to customize these styles with different fonts or formatting, please do so using Styles. Right click on the style you want to change and choose Modify.
- Please do not add tables without following accessibility procedures. Previous syllabi that contained critical information on the first page without a table do not meet accessibility requirements.

THE BASICS

About Your Instructor

Name: Insert info here

The best way to reach me is: Insert info here

Phone number: Insert info here

Email: Insert info here

Office location (and/or link if appropriate): Insert info here

Office hours: Insert info here

To schedule a conference outside of office hours: Insert info here

About Your Course

Instructional Methodology: Delete these instructions after following them: Choose the correct option and delete the other options

Classroom Section: This course is taught in the classroom primarily as a lecture/discussion course.

DLS—Synchronous Virtual Class Meetings Required: Instruction is fully online with required online meetings during the specified days and times listed.

ONL—Online: Instruction and testing are fully online without required class times.

HYC—Hybrid Classroom: Instruction is mostly on-campus with remaining instruction online.

Synonym: Insert info here **Section:** Insert info here

Meeting location: Insert info here **Meeting times:** Insert info here

Prerequisites: MATH 1325 or MATH 2413 with C or better.

Required Materials

Textbook: *Discrete Mathematics with Applications*, 5th Edition by Epp. Cengage Learning ISBN: 9781337694193

Calculator: The use of calculators or computers in order to perform routine computations is encouraged in order to give students more time on abstract concepts. Most ACC faculty are familiar with the TI family of graphing calculators. Hence, TI calculators are highly recommended for student use. Other calculator brands can also be used. Your instructor will determine the extent of calculator use in your class section.

Other Technology: **Delete these instructions after following them:** Delete webcam info if it does not apply; add any other needed technology. Access to a webcam and microphone are required for this course. Eligible students can check out required technology at <https://www.austincc.edu/students/student-technology-services>.

COURSE CALENDAR

Delete these instructions after following them: This is the recommended 16-week calendar from the course committee. See the document "Suggested Course Calendars" for other options and customize this chart as appropriate.

Note: Schedule changes may occur during the semester. Any changes will be announced in class and posted as a Blackboard Announcement.

Week 1

Section 2.1 and Section 2.2	Logical Form and Logical and Logical Equivalence and Conditional Statements	Notes:
Section 2.2 and Section 2.3	continue Conditional Statements and Valid and Invalid Arguments	

Week 2

Section 2.3 and Section 2.4	Valid and Invalid Arguments and Digital Logic Circuits	
Section 3.1	Predicates and Quantified Statements I	

Week 3

Section 3.2	Predicates and Quantified Statements II	
Section 3.3	Statements with Multiple Quantifiers	

Week 4

Section 3.4	Arguments with Quantified Statements	
Test 1		

Week 5

Section 4.1	Direct Proof and Counterexample (Part 1)	
Section 4.2	Direct Proof and Counterexample (Part 2) Rational Numbers	

Week 6

Section 4.3	Direct Proof and Counterexample (Part 3) Divisibility	
Section 4.4	Direct Proof and Counterexample (Part 3) Divisibility	Notes: Some modular arithmetic: Is 9^{2000} congruent to $1 \pmod{80}$?

Week 7

Section 4.4	Direct Proof and Counterexample (Part 4) Division into Cases and The Quotient Remainder Theorem	
Section 4.4 and Section 4.6	Indirect Argument: Contradiction and Contraposition	

Week 8

Section 4.6	Indirect Argument: Contradiction and Contraposition	
Section 4.7	Indirect Argument: Two Classical Theorems	

Week 9

Section 4.8	Application: Algorithms The Euclidean Algorithm	Notes: Find x and y integers such that $ax + by = \gcd(a, b)$.
Test 2		

Week 10

Section 5.1 and Section 5.2	Sequences and Mathematical Induction (Part 1)	
Section 5.3	Mathematical Induction (Part 2)	

Week 11

Section 5.4	Strong Mathematical Induction and The Well-Ordering Principle	Notes: Proof by smallest counterexample. Induction in disguise.
Section 5.4 and Section 5.6	Defining Sequences Recursively	Notes: Hands on with The Tower of Hanoi.

Week 12

Section 5.6 and Section 5.7	Solving Recurrence Relations by Iteration	
Section 6.1 and Section 6.2	Set theory and Properties of Sets	

Week 13

Section 6.2	Properties of Sets	Notes: A few mappings between sets (functions). One to one: The codomain gets mapped to at most once. Onto: The codomain gets mapped to at least once. One to one correspondence (exactly once)
Test 3		

Week 14

Section 8.1 and Section 8.2	Relations on Sets and Reflexivity, Symmetry, and Transitivity	
Section 8.2 and Section 8.3	Equivalence Relations	

Week 15 (Optional week)

Section 8.4	Modular Arithmetic with Application to Cryptography (RSA)	
Section 8.5	Partial Order Relations	

Week __ (Another Optional week if exams were at the testing center or instructor had a faster pace)

Section 7.4	Cardinality with Applications to Computability	
Section 7.4 and review	Continue with Cardinality and Review	

Optional weeks: The pace of the course is relax and you could have 1 to 2.5 optional weeks

Week 16

Test 4 (Final) Part 1		
Test 4 (Final) Part 2		

Important Dates

Last day to withdraw: Insert date here

Holidays: Insert ACC holidays for current semester

(Please note these are the **ONLY** holidays this semester.)

Making Time to Learn

We learn math by thinking about and working on mathematical problems, which takes time. Practice is crucial in a math course. To ensure that you have adequate time, set aside 8-12 hours per week outside of class time to practice and study for this course. Ask for help immediately when something isn't clear.

GETTING HELP

ACC provides several free resources for students who need help; descriptions and links are below:

Office hours: Another name for office hours is "student hours." This is the time your instructor has set aside to answer student questions, so feel free to drop by if you have questions. Office hours may be virtual or on campus; see information above.

Instructional Associates: Instructional Associates specific to the course you are taking are available for tutoring. To make an appointment, go to <https://sites.google.com/a/austincc.edu/math-students/meet/list> and then click on your course.

Learning Labs: The ACC Learning Labs provide tutoring in math and other subjects. To schedule an appointment, go to <https://www.austincc.edu/students/learning-lab>. This site includes information about in person and virtual tutoring options.

Academic Coaching: Academic coaches offer extra support to students with study strategies; they want to help you learn to be an active participant in your own learning process. For more information or to make an appointment with an academic coach, go to <https://www.austincc.edu/students/academic-coaching>.

ACC Student Services: Services are offered in many areas, including Academic, Financial, Personal, and Technology Support. For more information, go to <https://www.austincc.edu/student-support>.

GRADES

Delete these instructions after following them: Grading criteria must be clearly explained in the syllabus. The criteria should specify the number of exams and other graded material (homework, assignments,

projects, etc.). **Instructors must include where students can access their grades.** Instructors should discuss the format and administration of exams. Guidelines for other graded materials, such as homework or projects, should also be included in the syllabus. An example is given below; you should modify it to fit your course.

Grade Components

Tests: 80%

Homework: 10%

Quizzes: 5%

Other: 5%

Grading Scale

A: 90 - 100

B: 80 – 89

C: 70 – 79

D: 60 – 69

F: < 60

Where can I find my grades?

Grades will be posted in Blackboard.

What will we do in this class?

Tests: Insert info here

Homework: Insert info here

Quizzes: Insert info here

Group work: Insert info here

What happens if I miss something?

Dropped Grade Policy: Insert info here

Late Work Policy: Insert info here

Missed Exam Policy: Insert info here

Delete these instructions after following them: Write something that reflects your expectations to add to the statement below. Here's one suggestion: "In this class, missing more than 10% of the class time over the semester is considered unsatisfactory. That is approximately four classes of a class which meets two days a week in the 16-week semester."

Attendance/Class Participation: Regular and punctual class attendance is expected of all students. If attendance or compliance with other course policies is unsatisfactory, the instructor may withdraw students from the class.

COURSE CONTENT

Course Description

Credit Hours: 3, Contact Hours: 3

MATH 2305 - Discrete Mathematics (3-3-0). A course designed to prepare math, computer science and engineering majors with a background in abstraction, notation and critical thinking for the mathematics most directly related to computer science. Topics to be covered include formal logic, various proof techniques, mathematical induction, recursion, sets and relations. The number of topics required for coverage has been kept modest so as to allow adequate time for students to develop theorem-proving skills.

Course Rationale

One major part of the course focuses on learning to write logically sound mathematical arguments and to analyze such arguments. Students who enroll in this course are majoring primarily in mathematics, computer science, engineering, planning to transfer these credits to a four-year institution.

Course Objectives

The main objective of the course is to introduce the student to the concept of "proof" applied in different settings.

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

- 1.1 Use mathematically correct terminology and notation.
- 1.2 Discuss definitions and diagram strategies for potential proofs in logical sequential order without mathematical symbols (plain English).
- 1.4 Construct direct, indirect proofs and provide strategies for division into cases.
- 1.5 Use counterexamples.
- 1.6 Apply logical reasoning to solve a variety of problems.

2. Propositional Logic

- 2.1 Write English sentences for logical expressions and vice-versa. Use standard notations of propositional logic.
- 2.2 Complete and use truth tables for expressions involving the following logical connectives: negation, conjunction, disjunction, conditional, and biconditional.
- 2.3 Define and use the terms: proposition (statement), converse, inverse, contrapositive, tautology, and contradiction.
- 2.4 Apply standard logical equivalences. Be able to prove that two logical expressions are or are not logically equivalent.
- 2.5 Determine if a logical argument is valid or invalid by tables or trees. Apply standard rules of inference including (but not limited to) Modus Ponens, Modus Tollens, Transitivity, and Elimination. Recognize fallacies such as the Converse Error and the Inverse Error.

3. Predicate Logic

- 3.1 Translate between English sentences and logic symbols for universally and existentially quantified statements, including statements with multiple quantifiers.
- 3.2 Write the negation of a quantified statement involving either one or two quantifiers.
- 3.3 Determine if a quantified statement involving either one or two quantifiers is true or false.

4. Elementary Number Theory

- 4.1 Construct correct direct and indirect (contradiction and contraposition) proofs involving concepts from elementary number theory such as even and odd integers, rational and irrational numbers, and divisibility.
- 4.2 Find a counterexample to show that a proposed statement involving concepts from elementary number theory is false.
- 4.3 State and use the Quotient-Remainder Theorem (Division Algorithm) and apply the mod, div, floor and ceiling in the proof of the Division Algorithm.
- 4.4 Apply the Euclidean Algorithm.

5. Mathematical Induction

- 5.1 State the Principle of Mathematical Induction.
- 5.2 Construct induction proofs involving summations, inequalities, divisibility arguments, counting arguments, recurrence relation correctness and incorrectness.

6. Set Theory

- 6.1 Use set notation, including the notations for subsets, unions, intersections, differences, complements, cross (Cartesian) products, and power sets.
- 6.2 Prove that a proposed statement involving sets is true, or give a counterexample to show that it is false. Be able to prove, if so, that a set is empty.

9. Relations

- 9.1 State the definitions of binary relation, reflexive, symmetric, transitive, equivalence relation, equivalence class, class representative, and partition.
- 9.2 Show that a binary relation on a set is an equivalence relation, or give a counterexample to show that it is not.
- 9.3 Given an equivalence relation on a set, find the equivalence classes of the relation and show that they form a partition of the set.
- 9.4 Show that congruence modulo m is an equivalence relation on the integers, and that congruence classes modulo m form a partition of the integers.
- 9.5 Sequences. Recursive Relations. Solution by Iteration. Check Correctness by Induction. First Order Difference Equations. Second Order Difference Equations.

The course will cover sections from the following chapters in order to meet the outcomes above:

Core Sections:

- Logic (Chapters 2 and 3) Sections 2.1 to 2.4 and Sections 3.1 to 3.4
- Number Theory (Chapter 4) Section 4.1 to 4.4 and 4.6 to 4.8
- Induction and Sequences (Chapter 5) Sections 5.1 to 5.4 and 5.6, 5.7
- Set Theory (Chapter 6) Sections 6.1 and 6.2
- Relations (Chapter 8) Sections 8.1, 8.2 and 8.3

Optional Sections (two to five sections from below):

- Functions (Sections 7.1 to 7.3)
- RSA (Section 8.4)
- Cardinality (Section 7.4)
- Partial Order Relations (Section 8.5)
- Discrete Probability (Sections 9.8 and 9.9)
- Pigeonhole Principle (Section 9.4)
- Graphs (Sections 10.1 to 10.4)
- Counting (Sections 9.2 to 9.6)
- Analysis of Algorithm Efficiency (Sections 11.1 to 11.5)

Student Learning Outcomes

1. Upon successful completion of the course, a student should be able to:
2. Construct mathematical arguments using logical connectives and quantifiers.
3. Verify the correctness of an argument using propositional and predicate logic and truth tables.
4. Demonstrate the ability to solve problems using counting techniques and combinatorics in the context of discrete probability.
5. Solve problems involving recurrence relations and generating functions.
6. Use graphs and trees as tools to visualize and simplify situations.
7. Perform operations on discrete structures such as sets, functions, relations, and sequences.
8. Construct proofs using direct proof, proof by contraposition, proof by contradiction, proof by cases, and mathematical induction.
9. Apply algorithms and use definitions to solve problems and prove statements in elementary number theory.

General Education Competencies

1. Critical Thinking: gathering, analyzing, synthesizing, evaluating and applying information is covered in every SLO.
2. Quantitative and Empirical Reasoning: applying mathematical, logical, and scientific principles and methods is covered in every SLO.
3. Technology Skills: using appropriate technology to retrieve, manage, analyze, and present information is covered in SLOs # 1, 2, 3, 5, and 7.
4. Written, Oral and Visual Communication: communicating effectively adapting to purpose, structure, audience and medium is covered in every SLO.

THE DETAILS

[Delete these instructions after following them: Remove the following two paragraphs if your class is not online]

Distance Education Information: This class is fully online. Successful online students actively participate in class on a regular basis just like in an on-campus class and avoid putting off classwork until the last minute. This includes reading assignments, taking quizzes and tests, and any other activities assigned by your professor. You will need to stay motivated and routinely log in to your classes in order to keep on top of your assignments.

Students will use the Blackboard learning management system for assignment instructions, submitting assignments, and collaboration. Students are encouraged to read ACC Distance Education General Information available at <https://online.austincc.edu/faq/>.

First Day Access: To enhance your learning experience and provide affordable access to the right course material, this course is part of an inclusive access model called First Day™. You can easily access the required materials for this course through Blackboard, at a discounted price, and benefit from single sign-on access. Austin Community College includes the discounted price as a course fee in your registration fees for this course.

It is NOT recommended that you Opt Out, as these materials are required to complete the course. You can choose to Opt Out on the first day of class, but you will be responsible for purchasing your course materials

at the full retail price and access to your materials may be suspended. See your course in Blackboard for details.

Withdrawal Policy: It is the responsibility of each student to ensure that his or her name is removed from the roll should he or she decide to withdraw from the class. The instructor does, however, reserve the right to drop a student should he or she feel it is necessary. If a student decides to withdraw, he or she should also verify that the withdrawal is submitted before the Final Withdrawal Date. The student is also strongly encouraged to retain their copy of the withdrawal form for their records.

Students who enroll for the third or subsequent time in a course taken since Fall 2002 may be charged a higher tuition rate for that course. State law permits students to withdraw from no more than six courses during their entire undergraduate career at Texas public colleges or universities. With certain exceptions, all course withdrawals automatically count towards this limit. Details regarding this policy can be found in the ACC college catalog.

Reinstatement Policy: Students who withdrew or were withdrawn will not be reinstated unless they have completed all coursework, projects, and exams necessary to place them at the same level of course completion as the rest of the class. Reinstatement is up to the instructor's approval.

Incomplete Grade Policy: Incomplete grades (I) will be given only in very rare circumstances. Generally, to receive a grade of "I", a student must be up to date on coursework and have a passing grade, and after the last date to withdraw, have a legitimate reason that prevents course completion. An incomplete grade cannot be carried beyond the established date in the following semester. The completion date is determined by the instructor but may not be later than the final deadline for withdrawal in the subsequent semester.

Communication with Your Instructor: All e-mail communication to students will be sent solely to the student's ACCmail account or math software if applicable, with the expectation that such communications will be read in a timely fashion. Likewise, students should use their ACCmail account or math software when communicating with instructors. Instructors will respond to student emails within 3 business days, if no response has been received by the student at the end of that time, then the student should send a reminder to the instructor.

Name Change Information: If you want to change how your name appears online at ACC, go to <https://www.austincc.edu/admissions/update-student-information/chosen-name>.

General College Policies: Policies that apply to all courses at ACC can be found here: <https://www.austincc.edu/offices/academic-outcomes-assessment/master-syllabi/college-policies>.