Discrete Mathematics

MACT 2131 **Course Syllabus** **Fall 2021**

Lecturer:
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MACT 2131 is an introductory course to the mathematical concepts and tools used in mathematics and computer science. Much emphasis is put on writing rigorous mathematical proofs and problem solving. The course covers the following topics.

1. Logic and Proofs
2. Naive Set Theory
3. Functions, Sequences and Series
4. Mathematical Induction
5. Number Theory
6. Matrices
7. Counting Techniques
8. Relations and Graphs

Main Textbook: Discrete Mathematics and its Applications; 7 th Ed.; 2012; by Kenneth H. Rosen; McGraw-Hill International Edition; ISBN 978-0-07-338309-5.

Supplementary Texts:
1) How to Think Like a Mathematician - A Companion to Undergraduate Mathematics; by Kevin Houston; Cambridge University Press; 2009.

2) Theory and Problems of Discrete Mathematics; 3rd Ed.; 2007; Schaum's Outlines Series, McGraw Hill; by Lipschutz and Lipson.

Course Objectives

1. Introduce students to several fields of mathematics including mathematical logic, set theory, number theory, combinatorics, relational structures, and graph theory.
2. Train students to write rigorous mathematical proofs in a clear enjoyable language.
3. Train students to use logical reasoning and improve their problem-solving skills.
4. Expose the students to Cantor's hierarchy of infinities.
5. Introduce students to the LaTeX software for scientific writing.
6. Develop mathematical maturity.

Course Outcomes

1. Construct truth tables of compound propositions involving logical operators.
2. Express English statements using propositional and predicate logic.
3. Decide whether two propositions are logically equivalent or not.
4. Decide whether a statement involving quantifiers is true or false in a given universe.
5. Construct a formal proof showing an argument is valid using rules of inference.
6. Use different techniques of proof such as direct proofs, contraposition and contradiction.
7. Finding counterexamples to refute universal statements.
8. Compute power sets and intersections, unions, complements, and Cartesian products of sets.
9. Determine whether a function is injective and whether it is surjective.
10. Generate arithmetic and geometric sequences, and express series using the Sigma notation.
11. Determine if a set is countable or uncountable.
12. Prove statements about natural numbers using the principle of mathematical induction.
13. Find the greatest common divisor using the Euclidean algorithm.
14. Acquire knowledge on prime numbers and state the Fundamental Theorem of Arithmetic.
15. Solve counting problems by sum and product rules, and pigeonhole principles.
16. Use permutations and combinations to find the number of ways to accomplish a mission.
17. Compute the sum, product, transpose, meet, join, and Boolean product of matrices.
18. Decide whether a relation is reflexive, irreflexive, symmetric, antisymmetric, or transitive.
19. Represent relations by directed graphs and by their matrix representation.
20. State the Handshaking lemma for simple graphs.

Course Plan

Section	Title	Section	Title
1.1	Propositional logic	5.1	Mathematical Induction
1.2	Applications of logic	5.2	Strong Induction
1.3	Propositional Equivalences	4.1	Divisibility
1.4	Predicate Logic	4.3	Prime numbers
1.5	Nested quantifiers	6.1	Basics of counting
1.6	Rules of Inference	6.2	Pigeonhole principle
1.7	Introduction to proofs	6.3	Permutations & Combinations
2.1	Sets	2.6	Matrices
2.2	Set operations	9.1	Relations
2.3	Functions	9.3	Representing relations
2.4	Sequences and Summations	9.5	Equivalence relations
2.5	Cardinality	9.6	Partial orders
		10.2	Graphs

Important Dates

First Exam	Tuesday	19 October 2021 6:00 – 7:15 pm
Second Exam	Tuesday	30 November 2021 6:00 – 7:15 pm
Project	Saturday	4 December 2021
Final Exam	Wednesday	15 December 8:30 - 10:30 am

Grading System

Grade Breakdown

20 Assignments	2 Exams	Project	Final Exam
1% each	20% each	Individual	Comprehensive
20%	40%	10%	30%

Tentative Letter Grade Conversion

F	D	D+	C-	C	C+	B-	B	B+	A-	A
0-51	52-54	55-59	60-64	65-69	70-74	75-79	80-84	85-88	89-91	92-100

Assignments

There are 21 assignments to be submitted on Gradescope, where each will be graded out of 5 marks. Submission during the first week after the deadline reduces 2 marks, while assignments submitted more than one week after the deadline will not be accepted.

A portion of the assignment's grade is reserved for the clarity of mathematical writing. Practicing mathematics does not only involve producing correct answers and valid arguments, but also requires clear and vivid presentation of your work. You are expected to write in complete English sentences using correct spelling and punctuation marks so that the reader of your work follows easily and enjoyably. I encourage you to discuss your ideas and collaborate with your peers and teaching assistants, however, you must use your own words and style of writing. *Cheating will not be tolerated.*

Attendance

Attendance and participation in lectures are essential to the education process at AUC. Missing lectures is a waste of important educational opportunities. Consequently, students are expected to attend all lectures throughout the semester. The event of missing more than 6 lectures during the semester for any reason will drop your final letter grade or fail you the course.

Academic Integrity

All course work is expected to be your own. Academic integrity is a commitment to five fundamental values: honesty, trust, fairness, respect and responsibility. Academic fraud and dishonesty includes cheating, plagiarism, fabrication, multiple submissions, obtaining unfair advantage, unauthorized access to academic or administrative systems, aiding and abetting, impersonation, threatening harm, and copyright infringement.

WARNING: AUC has zero-tolerance for violations of the academic integrity code.

Disability Policy
If you have established accommodations with Student Disability Services (SDS), please activate your accommodations via Simplicity and contact the instructor to discuss how the approved accommodations will be implemented in this course.

Important Notes

- Respect both my responsibility to teach and the right of other students to learn.
- Attend ALL lectures.
- Full attendance is highly appreciated.
- Lectures will start punctually on time, so please do not be late.
- Copied assignments will initiate an academic integrity case.
- More than 6 absences may drop your letter grade or fail you the course.
- Refrain from side-talking.
- Put your mobile phones on silent mode.
- Feel free to interrupt and ask questions.
- The ultimate goal of the lecture is to enrich your knowledge.

In this course, you may fall in love with the beauty of mathematics, and consequently decide to change majors or study a second major.