MA 2025 — BRIDGE TO ADVANCED MATHEMATICS (4-1)

Course coordinator information: Prof. Ralucca Gera, email username: rgera, phone (831) 224-2226.

Course description: MA2025 is a first course in discrete mathematics for students of mathematics and computer science. Topics include propositional and predicate logic up to the deduction theorem, methods of mathematical proof, naive set theory, properties of functions and relations, mathematical induction, an introduction to divisibility and congruences, an introduction to enumerative combinatorics, and an introduction to graphs and trees.

Course structure and format: The course meets 5 hours/week, as a combination of lecturing and discussions, with regular quizzes transitioning between the learned topics. Text: Discrete Mathematics and Its Applications, 7th Edition, K.H. Rosen, McGraw-Hill 2012.

Technical prerequisites and requirements: None.

Course learner outcomes and related content objectives:

Your goal is to develop the mathematical sophistication needed to understand and apply standard proof techniques to routine combinatorial problems. In doing this, you will

1. Prove established combinatorial results using the main proof techniques:
   - Direct proof
   - Contraposition
   - Contradiction
   - Induction
   - Combinatorial proof.
2. Demonstrate proficiency/competencies and strategies for:
   - Using counting techniques, permutations and combinations
   - Understanding functions, domains, range, sets and set operations, and relations
   - Explaining and using divisibility and modular arithmetic
   - Modeling problems using graph theory, and successfully using established theoretical graph concepts.
3. Apply the essential concepts and proof methods of combinatorics to be able to:
   - Distinguish between a correct and incorrect argument
   - Break down a result to analyze its parts and use the proof techniques to complete the proof
   - Assess the value of combinatorial results
   - Compare and contrast the strengths of combinatorial results

HOURS	TOPIC	SECTION
2-2	Propositional Logic and Applications Propositional Equivalences	1.1 (read 1.2) 1.3
2-4	Predicates and Quantifiers Nested Quantifiers	1.4 1.5
1-5	Rules of Inference	1.6
2-7	Introduction to proofs	1.7
2-9	Proof Methods and Strategy	1.8
1-10	Sets	2.1
1-11	Set Operations	2.2
2-13	Functions	2.3
1-14	Matrices	2.6

	Exponential and Logarithmic Function	A.2
1-15	Divisibility and Modular Arithmetic	4.1
	Integer Representations and Algorithms	4.2
1-16	Primes and Greatest Common Divisors	4.3
2-18	Mathematical Induction	5.1
	Strong Induction, Well-Ordering	5.2
2-20	Recursive Definitions, Structural Induction, Mutual Induction	5.3
1-21	The Basics of Counting	6.1
1-22	The Pigeonhole Principle	6.2
2-24	Permutations and Combinations	6.3
2-26	Relations	9.1
	Representing Relations	9.3
3-29	Closures of Relations	9.4
	Equivalence Relations	9.5
	Partial Orderings	9.6
1-30	Graphs, Models	10.1
	Terminology, Special Types	10.2
1-31	Representing Graphs, Isomorphism	10.3
1-32	Connectivity	10.4
1-33	Trees	11.1
1-34	Applications Of Trees	11.2
2-36	Tree Traversal	11.3
1-37	Spanning Trees	11.4
5-42	Exams and Holidays	

Last revised - 01/29/2019 – Prof. Ralucca Gera, MA2025 course coordinator.