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|---|---|---|
| A | **Course Number & Title** | **Discrete Mathematics – MTH 213** |
| B | **Pre/Co-requisite(s)** | Prerequisite: MTH 102 or MTH 103 |
| C | **Number of credits** | 3 |
| D | **Faculty Name** | Ayman Badawi |
| E | **Term/ Year** | Spring 2024 |

**F Sections**

| CRN | Days | Time | Location |
|---|---|---|---|
| 21039 | MW | 14:00 – 15:15 | NAB 009 |

**G Instructor Information**

| Office | Telephone | Email |
|---|---|---|
| NAB 262 | --- | abadawi@aus.edu |

**Office Hours:**

- MTWR: 13:00 – 14:00
- Or by appointment, email me

**H Course Description from Catalog**

(Equivalent to CMP 213). Covers propositional and predicate calculus, sets, major classes of functions and related algorithms, asymptotic analysis of functions, the principle of mathematical induction, proof techniques, recursive definitions, counting, relations, graphs, and trees.

*Computer science and computer engineering students who are not yet formally admitted to the second-year level in the major are not eligible to take this course.*

**I Course Learning Outcomes and Assessment Instruments**

| **Course Learning Outcomes (CLOs)** Upon completion of this course, students will be able to: | **Assessment Instrument(s)** |
|---|---|
| Basic number theory | Exam 1 and/or Final |
| CLO1: Apply logic and mathematical reasoning. | Exam 1 and/or Final |
| CLO2: Perform different methods of proof including induction and proof by contradiction. | Exams 1, 2 and/or Final |
| CLO3: Identify and apply basic set theory principles. | Exam 2 and/or Final |
| CLO4: Identify and apply relations, and functions including one-to-one and onto functions. | Exam 2 and/or Final |
| CLO5: Apply basic principles of counting including the addition and multiplication rules, and the pigeonhole principle. | Final |
| CLO6: Use graph theory concepts, such as minimum spanning tree and traveling salesman problem, to model and solve a variety of network and real-life problems. | Exam 1 and/or Final |
| CLO7: Analyze different type of algorithms and their complexity and the order of algorithms. | |

**J** **Mapping CLO's to PLO's**

| Course Learning Outcomes | Program Learning Outcome: *The BSMTH CLOs are listed at the end of this document* |
|---|---|
| 1. CLO1, CLO2 | PLO1, PLO2, PLO3, PLO5, PLO8 |
| 2. CLO3, CLO5 | PLO1, PLO8 |
| 3. CLO4 | PLO1, PLO6, PLO8 |
| 4. CLO6 | PLO6, PLO8 |
| 5. CLO7 | PLO1, PLO6 |

**K** **Textbook and other Instructional Material and Resources**

Required: Badawi- Class- Notes, materials on I-Learn, essential old quizzes, notes, and exams on the MTH 213 webpage: https://ayman-badawi.com/MTH213.html

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(Optional) Susanna S. Epp, Discrete Mathematics with Applications, Metric Edition, 5th Edition, Brooks/Cole, Cengage Learning, 2020.

- **Sponsored students**: Contact the Office of Sponsored Students (Ms. Maha: mshushaa@aus.edu) for instructions on obtaining your access code.
- If you are **not** a sponsored student, you can buy the access code from the Bookstore (AllPrint). Instructions will follow soon.

**L** **Teaching Methods**

Lectures, oral presentations, and group discussion. All lecture notes and videos will be available on iLearn.

**M** **Grading Scale, Grading Distribution, and Due Dates**

**Grading Scale (example)**

| | | | | | |
|---|---|---|---|---|---|
| 93 – 100 | 4.0 | A | 73.00 – 77.99 | 2.3 | C+ |
| 89.00 – 92.99 | 3.7 | A- | 68.00 – 72.99 | 2.0 | C |
| 86.00 – 88.99 | 3.3 | B+ | 62.00 – 67.99 | 1.7 | C- |
| 81.00 – 85.99 | 3.0 | B | 50.00 – 61.99 | 1.0 | D |
| 78.00 – 80.99 | 2.7 | B- | Less Than 50.00 | 0 | F |

**Grading Distribution**

| Assessment | Weight | Due Date (Week #) |
|---|---|---|
| Quizzes | 20% | Weekly/TBA |
| Exam 1 | 25% | Wednesday, March 20, In Class |
| Exam 2 | 25% | Monday, May 6, In Class |
| Final Exam | 30% | TBA |
| Total | 100% | |

**N** **Explanation of Assessments**

There will be two exams, quizzes, and a comprehensive final exam.

- No make-up quiz will be given. If you miss a quiz for whatever reason, you will get zero for that quiz. *The lowest quiz grade will not count toward your grade, however.*
- With a valid written excuse and making immediate arrangements with the instructor, a missed exam might be replaced with a make-up exam or the grade of the final exam and/or the average grade of all tests (including final) and/or quizzes

**O** **Attendance**

Students in this course are required to follow the AUS Attendance Policy as outlined in the *AUS Undergraduate Catalog.*

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|---|---|---|
| P | **Student Academic Integrity Code Statement** | Students MUST read the Student Academic Integrity Code outlined in the *AUS Undergraduate* Catalog and abide by the standards for academic conduct, students' rights and responsibilities and procedures for handling allegations of academic dishonesty. |
| Q | **Generative AI Course Policy** | **It is considered an academic integrity violation to represent the output of a generative artificial intelligence tool as your own work.** |

# Schedule(but not in order; I recommend following class notes)

| WEEK | CHAPTER | NOTES |
|---|---|---|
| 1 | 1: **Speaking Mathematically** | 1.1 Variables<br>2.1 Logical Forms and Logical Equivalence |
| 2 | 2: **The Logic of Compound Statements** | 2.2 Conditional Statements<br>2.3 Valid and Invalid Arguments |
| 3 | 3: **The Logic of Quantified Statements** | 3.1 Predicates and Quantified Statements I<br>3.2 Predicates and Quantified Statements II<br>3.3 Statements with Multiple Quantifiers<br>3.4 Arguments with Quantified Statements |
| 4 | 4: **Elementary Number Theory and Methods of Proofs** | 4.1 Direct Proof and Counterexample I: Introduction<br>4.2 Direct Proof and Counterexample II: Writing Advice<br>4.3 Direct Proof and Counterexample III: Rational Numbers |
| 5 | | 4.4 Direct Proof and Counterexample IV: Divisibility<br>4.5 Direct Proof and Counterexample V: Division into Cases and the<br>4.7 Indirect Argument: Contradiction and Contraposition<br>4.8 Indirect Argument: Two Famous Theorems |
| 6 | 5: **Sequences, Induction, and Recursion** | 5.2 Mathematical Induction I<br>5.3 Mathematical Induction II<br>5.4 Strong Mathematical Induction |
| 7 | | 5.6 Defining Sequences Recursively<br>5.7 Solving Recurrence Relations by Iteration<br>5.8 Second-Order Linear Homogenous Recurrence Relations |
| 8 | 6: **Set Theory** | 1.2 The Language of Sets<br>6.1 Definitions and the Elements Method of Proof<br>6.2 Properties of Sets<br>6.3 Disproof and Algebraic Proofs |
| 9 | 7: **Functions** | 1.3 The language of Relations and Functions<br>7.1 Functions Defined on General Sets<br>7.2 One-to-One and Onto, Inverse Functions |
| 10 | 8: **Relations** | 8.1 Relations on Sets<br>8.2 Reflexivity, Symmetry, and Transitivity<br>8.3 Equivalence Relations<br>8.4 Modular Arithmetic with Applications to Cryptography |
| 11 | 9: **Counting and Probability** | 9.1 Introduction<br>9.2 Possibility Tree and the Multiplication Rule<br>9.3 Counting Elements of Disjoint Sets: the Addition Rule<br>9.4 The Pigeonhole Principle |
| 12 | | Introduction to Graphs<br>10.1 Trails, Paths, and Circuits |

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|---|---|---|
| 13 | 10: **Graphs and Trees** | 10.4 Trees<br>10.5 Rooted Trees |
| 14 | 10: **Graphs and Trees/algorithm complexity** | 10.6 Spanning Trees and Shortest Paths |
| 15 | 11: **Analysis of Algorithm Efficiency** | 11.3 Application: Analysis of Algorithm Efficiency I,<br>11.2 O-, Omega-, and Theta-Notations |
| 16 | **Final Exam (Comprehensive): TBA** | |

* The teaching schedule is subject to change at the instructor's discretion, and students will be informed accordingly.

## BSMTH Program Learning Outcomes

**PLO1**: Demonstrate knowledge and understanding of diverse areas in mathematics such as analysis, algebra, discrete mathematics, and applied mathematics.

**PLO2**: Construct and effectively communicate valid mathematical arguments.

**PLO3**: Demonstrate a solid grounding in the ideas and techniques of mathematics.

**PLO4**: Apply mathematical analysis and mathematical skills to problems in other disciplines.

**PLO5**: Use discrete mathematical concepts in a variety of contexts such as algorithm development, computer programming and network development and implementation.

**PLO6**: Demonstrate the ability to identify and carry out thoughtful approaches to problem solving.

**PLO7**: Define and execute simple research tasks, and assist in more complex research tasks as required for professional work.

**PLO8**: Formulate a problem in mathematical terms from descriptions written in language specific to disciplines associated with engineering, finance and the natural sciences.

**PLO9**: Obtain the research skills necessary to adapt to change and remain current in the field and continue to learn new information, skills and concepts.