MATH 226 – DISCRETE MATHEMATICS

1. **Course Description**:
   - This course explores discrete mathematical objects used to characterize sequential processes. One of the main goals is to help students to make a progress in their ability to construct and present a logically correct argument. Recursive definitions are very important topic that should help students in their Computer Science studies. We analyze fundamental mathematical notions of sets and counting. To introduce mathematical objects within sets we study the notion of relations. Our brief discussion of Boolean algebras is important for the proper understanding of Computing Architecture. We also analyze graphs, trees and some related algorithms.
2. **Topics Covered**
   - **Propositional calculus**
     - Logic of compound statements; truth tables
     - Conditional statements; contrapositive
     - Valid and invalid arguments
     - Digital logic circuits
     - Number systems and circuits for addition.
   - **Predicate calculus**
     - Models of a given signature
     - Quantifiers
     - Proofs
     - Divisibility of integers
     - Proofs by contradiction and contraposition
     - Euclidean algorithm.
   - **Sets**
     - Basic set operations; Venn diagrams; Cartesian product
     - Cardinality; pigeonhole principle
     - Russell's paradox and halting problem
     - Boolean algebra, including applications to digital logic design
     - Minimization of circuits
     - Sequences and summation
     - Mathematical induction.
   - **Counting**
     - Product rule; addition rule; principle of inclusion and exclusion
     - Permutations
     - Combinations
     - Binomial theorem
     - Finite probability space; probability measure; events
     - Conditional probability; independence; Bayes' theorem.
   - **Recursion and recurrence relations**
     - Recursion
     - Solution of linear, first and second order, recurrence relations
     - Use of induction to verify formulas for recursively defined sequences.

- Use of recursion to analyze algorithms.

- **Relations**
  - Binary relations; functions
  - Reflexive, symmetric, and transitive properties
  - Equivalence relations
  - Congruences and modular arithmetic
  - Partial orders; linear orders.
- **Graphs**
  - Introduction to graphs
  - Euler paths and circuits; Hamiltonian paths; Floyd's algorithm
  - Matrix representations of graphs
  - Graph isomorphism.
- **Trees**
  - Characterization of trees; decision trees
  - Binary trees
  - Rooted trees; Huffman code.
- **Networks and tree algorithms**
  - Spanning trees
  - Minimum spanning trees using Kruskal's algorithm
  - Minimum spanning trees using Prim's algorithm.
- **Modeling computation**
  - Languages and grammars
  - Finite state machines.

3. **What to expect?**

- **Time: The most common term lengths are listed below; others would be proportionate. Outside of class time is studying, completing homework, reviewing, etc.**

Length of term	In-class time	Out-of-class time (min.)	Total hours/wk (minimum)	Total Term hours (minimum)
17 weeks	4 hrs/wk	8 hrs/wk	12	204

- Technology: Graphing technology is used.
- Grading: Students who earn a grade of C or higher in Math 226 will pass this course.

4. **Who should enroll**?

- This course is strongly recommended for students in CS and Math majors who have completed Math 150 (Calculus I) with a grade of C or better. It could be useful for any student who majors in STEM.

5. **What prior knowledge students need to know to be successful?**

- Integers
- Basic knowledge of functions
- Reasoning
- Elementary problem solving

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