Syllabus

MAT 220 Discrete Mathematics for Computing

General Information

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Author Timothy Biehler

Department Mathematics

Course Prefix MAT

Course Number 220

Course Title Discrete Mathematics for Computing

Course Information

Catalog Description This course introduces students to ideas and techniques from mathematics that are widely used in computer science. Topics include the fundamentals of logic (propositional and predicate calculus), set theory, relations, recursive structures, and combinatorics. This course will increase students' mathematical sophistication and ability to handle abstract problems.

Credit Hours 3

Lecture Contact Hours 3

Lab Contact Hours 0

Other Contact Hours 0

Grading Scheme Letter

Prerequisites

MAT 271

Co-requisites

None

First Year Experience/Capstone Designation

This course DOES NOT satisfy the outcomes applicable for status as a FYE or Capstone.

SUNY General Education

This course is designated as satisfying a requirement in the following SUNY Gen Ed category
Mathematics (and Quantitative Reasoning)

FLCC Values

Institutional Learning Outcomes Addressed by the Course
Inquiry and Perseverance

Course Learning Outcomes

Course Learning Outcomes

1. Apply precise mathematical reasoning in the use and analysis of course content.
2. Justify conclusions supported by appropriate evidence, presented with proper terminology and notation.
3. Articulate clear solutions to problems by applying definitions, properties, techniques and logical structure included with course concepts.

Outline of Topics Covered

I. **Logic**
- **Propositional Logic**
  - **Operators: Negation, conjunction, disjunction, conditional, biconditional**
  - **Conditional statements: Converses, inverses, contrapositves, and negations**
  - **Arguments and valid conclusions**
- **Propositional equivalences and truth tables**
- **Predicates and quantifiers**
- **Multiple quantifications (nested quantifiers)**

II. **Principles of Mathematical proof**
- **Axioms, lemmas, and theorems**
- **Direct proof**
- **The explosion principle ("ex contradictione quodlibet")**
- **Proof by contradiction**

III. **Set Theory**
- **Naive concept of a set, set elements, subsets and set equality**
- **Formal representation of a set**

- **Russell's paradox and the comprehension axiom**
- **Set operations: Union, intersections, complement, set difference**
- **Set equalities: Logically equivalent formulas and the element method for demonstrating set equality**
- **Power set and an algorithm for its enumeration**
- **Set partitions**
- **Cartesian products**

IV. Relations and functions

- **Binary, ternary, and n-ary relations**
- **Properties of binary relations**
  - **Partial, total, one to one, and onto**
  - **Inverse relations**
  - **Compositions: Boolean product**
- **Properties of relations of a set on itself**
  - **Representations: Matrices and graphs**
  - **Reflexive, symmetric, anti-symmetric, and transitive**
  - **Equivalence relations using partitions**
  - **Equivalence relations relations/functions**
  - **Z[n] and arithmetic on Z[n]**
  - **Partial and total orderings**
- **Functions**
  - **Injections (one-to-one), surjections (onto), bijections**
  - **Bijections and set cardinality**
  - **Countable and uncountable sets**
  - **Inverse functions**
  - **Recursive defintions of functions**
  - **Operations on functions**

V. Recursive Definitions and Mathematical Induction

- **Recursively defined sequences**
- **Recursively defined sets, strings and formulas**
- **Mathematical induction:Â Complete and structural**

VI. Combinatorics

- **Basic principles of counting:Â sum and product rules**
- **The pigeonhole principle**
- **Permutations and combinations**
- **The binomial theorem**
- **Combinations with repetitions**
- **The inclusion-exclusion principle**

VII. Optional topics (as time and student needs permit)

- **Closures of relations**

- **Topological and well-founded ordering**
- **Rings: Properties and homomorphisms**
- **Discrete probability**
  - **Conditional probability**
  - **Independence, Bernoulli trials, binomial distribution**
- **Number theory**
  - **Prime numbers and their properties**
  - **Applications to data encryption**
- **Non-classical logic**
  - **Fuzzy logic, multi-valued logics, paraconsistent logics**