University of Arkansas – Fort Smith
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General Syllabus

MATH 3303 Discrete Mathematics

Credit Hours: 3 Lecture Hours: 3 Laboratory Hours: 0

Prerequisites: MATH 1903 Introductory Discrete Mathematics

Effective Catalog: 2019-2020

I. Course Information

A. Catalog Description:

Topics include a study of graph theory, trees, decision trees, critical path analysis, languages, Turing machines, combinatorics, efficiency of algorithms, logic, Boolean algebra, and social choice.

II. Student Learning Outcomes

A. Subject Matter

Upon completion of this course, the student will be able to:

1. Apply given algorithms to processes and identify the algorithms involved in certain mathematical processes and compare the complexity of various algorithms.
2. Model simple computations using a Turing machine construction.
3. Classify computational processes as solvable, computable, tractable, and intractable.
4. Apply the fundamental counting principle, permutation and combination formulas, and the pigeon-hole principle to problems in counting the number of possible outcomes of a process.
5. Work with relations defined recursively, solve simple recurrence relations for the general term, and apply recurrence relations to the analysis of time needed to apply a simple algorithm.
6. Use graphs to model processes in programming, transportation, computer networking, and other areas.
7. Identify paths and cycles in graphs, determine the existence of certain types of paths, and use algorithms to search for a shortest path through a given graph.
8. Construct a matrix representation of a given graph and determine whether different graphs are isomorphic.

9. Identify trees, spanning trees, and minimal spanning trees, and apply tree structures to problems in decision-making, efficient sorting, and language design.
10. State the axioms of a Boolean algebra and recognize mathematical structures which obey these axioms.
11. Apply the properties of Boolean algebras to the design of electronic logic circuits.
12. Apply various methods of vote counting and defend a conclusion regarding the "best" method for a given situation.

B. University Learning Outcomes

Analytical Skills
Critical Thinking Skills: Students will use critical thinking skills to understand mathematical language and techniques necessary to formulate a logical argument. Students will develop a fundamental understanding of numbers and counting principles.

Communication Skills (written and oral)
Students will argue the correctness of their proposed solutions to every problem through written arguments and/or oral presentations. Students will write logical proofs in a narrative format.

III. Major Course Topics

A. Counting methods
   1. Counting Elements of Disjoint Sets
   2. The Pigeonhole Principle
   3. Counting Subset of a Set
B. Algorithms, complexity of algorithms
   1. Real-Valued Functions of a Real Variable and Their Graphs
   2. O, Big Omeng, and Small Omeng Notations.
   3. Exponential and Logarithmic Functions: Graphs and Orders
C. Recurrence relations
   1. Linear Recurrence Relations
   2. Non-Homogeneous Recurrence Relation and Particular Solutions
   3. Generating Functions
D. Graph Theory
   1. Definitions and Basic Properties
   2. Trails, Paths, and Circuits
   3. Matrix Representations Graphs
   4. Isomorphisms of Graphs
E. Trees
   1. Definitions and Basic Properties
   2. Rooted Trees
   3. Spanning Trees and Shortest Paths
F. Boolean algebras and combinatorial circuits
   1. Operations

2. Axioms for a Boolean Algebra
3. Boolean Expressions and Functions.
4. Normal Forms
5. Isomorphisms