University of Arkansas – Fort Smith
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General Syllabus

MATH 1903 Introductory Discrete Mathematics

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

Prerequisite or corequisite: MATH 1453 Plane Trigonometry, or MATH 1715 Precalculus Mathematics, or required placement score

Effective Catalog: 2018~2019

I. Course Information

A. Catalog Description

Develops the foundations of discrete mathematics, including its applications to computer science and information technology. Serves as an introduction to more advanced material necessary in higher level mathematics and computer science courses. Topics include a study of logic, sets, relations, functions, algorithms, counting methods, graph theory and trees, and basic number theory.

B. Additional Information - None

II. Student Learning Outcomes

A. Subject Matter

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

1. Formulate and express arguments using symbolic logic.
2. Create and understand basic mathematical proofs about set theory.
3. Use basic mathematical techniques of direct and indirect proof including proof by contradiction, induction, and the use of counterexamples.
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. Apply given algorithms to processes and identify the algorithms involved in certain mathematical processes.
6. Determine and prove whether a given relation defines a function, and whether a given function is injective, surjective or bijective.

7. Use graphs to model processes in programming, transportation, computer networking, and other areas.
8. 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..
9. Identify trees, spanning trees, and minimal spanning trees, and apply tree structures to problems in decision-making, efficient sorting, and language design.
10. Prove basic results in number theory using modular arithmetic and the Euclidean algorithm

B. University Learning Outcomes

This course enhances student abilities in the following areas:

Analytical Skills

Quantitative Reasoning: Students will understanding mathematical language and the techniques necessary to formulate a logical argument. Students will analyze rules and meaning at every step. 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 on every problem. Students will write logical proofs in a narrative format.

Ethical Decision Making

Students will apply ethical frameworks to the process of logical argument applied in a variety of situations.

Global and Cultural Perspectives

Students will demonstrate understanding of how logic is used in a wide array of subjects outside Mathematics including computer science and philosophical debate.

III. Major Course Topics

A. Symbolic Logic Including Quantifiers
   1. Propositions and compound propositions
   2. Basic logical operations
   3. Propositions and truth tables
   4. Logical equivalence

B. Sets, Relations, and Functions
   1. Sets and elements
   2. Venn diagrams
   3. Set operations
   4. Functions
   5. Composition of functions

C. Methods of Proof
   1. Constructive proof
   2. Proof by contrapositive

3. Proof by contradiction
4. Proof by induction

D. Counting Methods
   a) Counting Elements of Disjoint Sets
   b) The Pigeonhole Principle
   c) Counting Subset of a Set

E. Algorithms
   1. Real-Valued Functions of a Real Variable and Their Graphs
   2. O, Big Omeng, and Small Omeng Notations.

F. Graph Theory
   1. Definitions and Basic Properties
   2. Trails, Paths, and Circuits
   3. Matrix Representations Graphs
   4. Isomorphisms of Graphs

G. Trees
   1. Definitions and Basic Properties
   2. Rooted Trees
   3. Spanning Trees and Shortest Paths

H. Basic Number Theory
   1. Locally compact field
   2. Lattices and duality over local fields
   3. Places of A-fields