

University of Arkansas – Fort Smith
5210 Grand Avenue
P.O. Box 3649
Fort Smith, AR 72913
479-788-7000

General Syllabus

MATH 4443 Combinatorics

Credit Hours: 3

Lecture Hours: 3

Laboratory Hours: 0

Prerequisites: MATH 3104 Foundations of Mathematics

Effective Catalog: 2020-2021

I. Course Information:

A. Catalog Description

Provide an overview of many of the fundamental ideas of combinatorics. Topics include a study of graph theory, recursion and generating functions, inclusion-exclusion, combinatorial designs and geometries, and algebraic combinatorics.

II. Student Learning Outcomes

A. Subject Matter

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

1. Identify structures contained in graphs such as paths, circuits and spanning trees.
2. Solve graph coloring problems
3. Use algebraic techniques to prove theorems about graphs and other combinatorial structures.
4. Use generating functions to both find closed form solutions and prove general results about recursively defined functions.
5. Apply the techniques of inclusion-exclusion to solve counting problems.
6. Prove theorems about the existence and structure of combinatorial designs and geometries.
7. Solve combinatorial problems where the objects studied have algebraic properties.

B. University Learning Outcomes

Analytical Skills

Quantitative Skills

Students will use sophisticated combinatorial techniques to find solutions to problems or to prove that no such solutions exist. They will prove the correctness of their results and the uniqueness of their solutions when appropriate. Students will utilize different

types of numerical arguments to count and represent situations, such as generating functions and Latin squares.

Communication Skills

Students will expand upon their mathematical communication skills by using new techniques to prove results in a logically valid and deductively precise manner.

III. Major Course Topics

- A. Graph Theory
 - 1. Definition and properties
 - 2. Graphs and matrices
 - 3. Graph models and distance
- B. Enumeration
 - 1. Exact
 - 2. Approximately
 - 3. Implicitly
 - 4. Bijectively
 - 5. Computationally
- C. Algebraic Combinatorics
 - 1. The Pigeonhole Principle
 - 2. Ramsey type problem and Ramsey numbers
 - 3. Bounds for Ramsey numbers
- D. Generating Functions
 - 1. Ordinary generating functions
 - 2. Modeling problem
 - 3. Partitions of integers
 - 4. Exponential generating functions