University of Arkansas – Fort Smith
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General Syllabus

MATH 3901 Mathematics Seminar

Credit Hours: 1 Lecture Hours: 1 Laboratory Hours: 0

Prerequisite: consent of instructor.

Effective Catalog: 2018~2019

I. Course Information

A. Catalog Description

Students will consider problems that cut across the boundaries of the standard courses and investigate general strategies of problem solving from several different branches of mathematics. Through active participation, students will discover new techniques for solving problems. In particular, students will learn strategies for approaching problems and identifying needed mathematical tools. The course will be graded pass/fail.

B. Additional Information

This course is intended to prepare mathematics majors for their senior project course. It will be graded pass/fail.

By working on challenging and nonstandard problems in a cooperative atmosphere, students will learn general problem solving strategies, gain a better understanding of the fundamental concepts from different areas of college mathematics, and develop confidence in their ability to deal with difficult mathematical questions.

II. Student Learning Outcomes

A. Subject Matter

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

1. Recognize different types of problems and different approaches to solving them.
2. Create new problems by adding or removing assumptions and conditions on those which they have previously solved.
3. Communicate mathematics by producing readable and correct mathematical arguments in various forms.
4. Clarify relationships among various mathematical topics and their applications.
5. Observe and recognize patterns and draw conclusions about data.

6. Recognize when and how to ethically attribute mathematical ideas and techniques to the original source.

B. University Learning Outcome

Analytical Skills
Critical Thinking Skills: Students will be introduced to the research process in mathematics of investigate, conjecture, and prove. Students will identify a research topic relating to mathematics, and develop a proposal to research this topic. Students will identify sources of information relevant to the research project. Students will review and evaluate a completed research project in mathematics.

Communication Skills (written and oral)
Students will complete written reports and oral presentations on completed research projects. Students will complete a written research proposal and make an oral presentation on the intended research.

Ethical Decision Making
Students will discuss research ethics, including the proper attribution of non-original ideas and ethical treatment of living research subjects.

III. Major Course Topics

A. The Pigeonhole Principle
   1. The basic principle
   2. Applications
B. Generating Functions
   1. Rational functions
   2. Operations on generating functions
   3. P-recursive sequence and holonomic generating functions
C. Congruences
   1. Geometry
   2. Congruence group
   3. Matrix congruence
D. Recurrences
   1. Linear recurrence relations
   2. Non-homogeneous recurrence relation
E. Inequalities
   1. Chained notation
   2. Sharp inequalities
   3. Power inequalities
F. Finite Differences
   1. Higher-order differences
   2. Newton's series
G. Number Theory
   1. Analytic number theory

2. Algebraic number theory
3. Diophantine geometry