

Spring 2013

## Math 321 – Introduction to Advanced Mathematics (3)

**Course Description:** Formal introduction to the concepts of logic, finite and infinite sets, functions, methods of proof and axiomatic systems. Learning mathematical expressions in writing is an integral part of the course.

**Prerequisite:** Math 243 (or concurrent) or 253A (or concurrent) or consent.

**Possible Textbooks:** *Tools of the Trade, Introduction to Advanced Mathematics* by Paul J. Sally, Jr. (Amer. Math. Soc.), *A Transition to Advanced Mathematics* by Smith, Eggen, St. Andre, *Chapter Zero, Fundamental Notions of Abstract Mathematics* by C. Schumacher, and *How to Read and Do Proofs* by D. Solow.

**Topics:** This course is primarily a methods course. It should focus on teaching students to understand, devise and communicate mathematical arguments. This includes both proofs and examples/counterexamples. Topics should include:

- Logic,
- direct and indirect proofs, proofs by induction,
- set theory,
- simple axiomatic systems.

The systems considered could be from calculus, group theory, ring theory, field theory, point set topology, metric spaces, incidence geometry, or any other subject that does not require an extensive background.

**General considerations:** The instructor for the class needs to comply with the requirements for a writing intensive class. Students may be required to give presentations and students should be encouraged to critique each other's presentations.

In this course students are expected to work on the transition from a computational approach to mathematics to an abstract and conceptual one, and this is rather difficult for some of them.

**Math 321 is a writing intensive class:** Clear, concise writing that captures the essence of an idea characterizes good mathematical writing. Towards that end, the student learns to read and understand mathematical definitions, and to read, understand, and write mathematical proofs.

At least half of each assignment should involve the writing of proofs, or the explanation of examples or counterexamples. This includes both homework and exams. The instructor should insist that assignments be written legibly using proper grammatical English, with an effort towards clarity and conciseness. Most students will have had little prior experience in writing mathematics, so instructor feedback is essential in obtaining this goal. Help for the student should come in the form of frequent and detailed grading of homework, solutions of problems in class exemplifying good exposition, and individual work with students in the office. Some instructors will return poorly written assignments with comments to the student, who must then rewrite and resubmit the work for grading.

The instructor should ensure that the writing assignments occupy at least the equivalent of 16 typewritten pages.

If written work (including homework and take-home exams, but not in-class exams) does not make up at least 40% of a student's course grade, the class syllabus must include the following statement: "*Students must adequately complete all writing assignments to pass the course with a D grade or better. Students who do not complete all writing assignments will fail the course*".

**Course objectives and Student Learning Outcomes.** Upon successful completion of Math 321, the student will be able to

- Develop and write direct proofs, proofs by contradiction, and proofs by induction.
- Formulate definitions and give examples and counterexamples.
- Understand the axiomatic approach to simple mathematical systems.

**Program Objectives.** In this junior level course students are introduced to basic methods of proof that are common to many areas of mathematics. Students will learn to write mathematical proofs (W) and may be required to do some reading without supervision.