MAT 512: ALGEBRA FOR TEACHERS

SPRING 2023

Basic Information

Instructor: Christian Schnell, christian.schnell@stonybrook.edu
Office: Math Tower 4–110
Course website: http://www.math.stonybrook.edu/~cschnell/mat512
Office hours: TBA
Grader: Giovanni Passeri, giovanni.passeri@stonybrook.edu

Course Description

Course information. "This three-credit course is an advanced course in algebra, and it is a credit-bearing course for a Master of Arts degree. This is not a course in high school algebra. The topics of study are of particular interest and relevance for high school teachers, but the mathematics should be challenging for you. One goal for this course is to build connections between algebra and other branches of mathematics, so you should feel free to attack any problem using any mathematics you know and understand. Modest effort should introduce you to some of the connections between abstract algebra and high school algebra; more vigorous effort will give you a solid introduction to a beautiful field of advanced mathematics. Plan to work hard, solve a lot of interesting problems, and develop your skills in finding patterns, making conjectures, and proving theorems." (Lisa Berger)

To do well in the course, you should have a solid background in undergraduate mathematics, and you should have completed a proof-based mathematics course such as MAT 511.

Exams. There will be three exams. Exam 1 and Exam 2 are midterm exams, and will most likely be near the end of February (Exam 1) and near the beginning of April (Exam 2). The final exam has already been scheduled by the University for **Wednesday, May 10**, from 5:30pm to 8:00pm. Please plan accordingly.

Homework, classwork, quizzes. Homework is an essential component of the course. I will assign and collect homework every week, and our grader (Giovanni Passeri) is going to grade a subset of the problems. Late homework will *not* be accepted. Certain assignments may also be completed and collected during class. We may have have (un)announced quizzes during class as well. Students are expected to be present for class, and missed classwork may not be completed for credit. The lowest two scores in the homework/classwork/quiz category will be excused at the end of the semester.

Textbook. The textbook for the course is "Integers, Polynomials, and Rings" by Ronald S. Irving.

Final grades. Your final grade for the course will depend on the folllowing four items:

(1) Homework, Quizzes, Classwork: 30%
(2) Exam 1: 20%
(3) Exam 2: 20%
(4) Final Exam: 30%

You can expect to get an `A` if your overall score is 88% or higher; a `B` if your overall score is 76% or higher; a `C` if your overall score is 64% or higher; and an `F` if your overall score is below 64%.

Guidelines for Writing Solutions to Homework

Purpose. First and foremost, this is an exercise in writing mathematics. Remember that communication is an important part of doing mathematics, and that explaining mathematics clearly to someone else improves your own understanding. All homework is expected to be clearly written and grammatically correct, in addition to being mathematically correct. Homework not meeting these requirements may be returned ungraded.

Due dates. Homework is due at the beginning of class. Late homework will *not* be accepted.

Collaboration. I encourage you to work on homework problems together, but you must write up the solutions on your own, in your own words, and based on your own understanding of the problem. Please do not look for answers to problems on the internet, or submit solutions or partial solutions from any online sources. If you need clarification on this policy, please ask me.

Learning Outcomes

The list of learning outcomes was created by Lisa Berger.

(1) Students describe the classical number systems used in high school (natural numbers, integers, rational, real and complex numbers) and relations among them.
(2) Students formulate and use the basic properties of algebraic operations (associativity, commutativity, distributivity).
(3) Students define basic algebraic structures such as groups, rings, and fields; and they recognize these structures in appropriate situations.
(4) Students define homomorphisms and isomorphisms and determine when a function meets these definitions.
(5) Students demonstrate their understanding of divisibility, divisor, greatest common divisor, prime, irreducible in the integers, and extend this understanding to the ring of polynomials and to other rings.
(6) Students formulate and prove the fundamental theorem of arithmetic and the Euclidean algorithm in the integers. Students extend these results to the ring of polynomials.
(7) Students use the Euclidean algorithm to determine a greatest common divisor.
(8) Students study and solve linear Diophantine equations.
(9) Students perform basic operations with congruence classes and identify congruence classes as elements of a residue ring.
(10) Students apply their understanding of modular arithmetic to study Diophantine equations.
(11) Students determine units in a ring.
(12) Students define the Euler function and formulate and prove properties of this function.
(13) Students formulate and prove Euler's totient theorem. Students use this to prove Fermat's little theorem and to solve congruence problems with large exponents.
(14) Students define zero divisor and integral domain.
(15) Students solve linear equations in residue rings.
(16) Students prove that polynomials with coefficients in a ring form a ring.
(17) Students define ideal in a ring, kernel of a ring homomorphism, quotient ring.
(18) Students interpret the simplest algebraic extension of fields as quotient rings of the polynomial ring over the field.
(19) Students express a symmetric polynomial as a product of elementary symmetric polynomials; students use this expression in problem solving.
(20) Students formulate and prove Vieta's formulas.
(21) Students give an example of a ring that is not a unique factorization domain.

Policy Statements

Disability Support Services. If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, Educational Communications Center Building, room 128, at (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential. Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website: http://www.stonybrook.edu/ehs/fire/disabilities.

Academic Integrity. Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html.

Critical Incident Management. Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn.