MAT 512 ALGEBRA FOR TEACHERS

SPRING 2022

Course Meeting: Mondays/Wednesdays, 4:25 - 5:45, Math Tower Room 4-130
Instructor: Lisa Berger
Office: Math 4-100A
Email: lisa.berger@stonybrook.edu
Web page: `http://www.math.sunysb.edu/~lbrgr/`
Current Office Hours:

Tuesdays: 5:00-6:00 Virtual
Wednesdays: 2:30-3:30 in 4-100A
By appointment.

Office hours may be adjusted to accommodate the instructor's schedule and/or student needs. Students unable to meet during scheduled office hours are encouraged to schedule an appointment with the instructor.

Grader: Hanbing Fang
Email: Hanbing.Fang@stonybrook.edu

General 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.

0.1. **Pre-requisites.** A *minimum* pre-requisite for this course is completion of MAT 511 or other course in mathematical proof. A strong background in undergraduate mathematics is also assumed.

Textbook. We will be using the textbook *Integers, Polynomials, and Rings*, by Ronald S. Irving.

Homework/Class Work/Quizzes. Homework is an essential component of the course. Homework will be assigned and collected regularly, and selected problems will be graded. Homework is due at the beginning of the class period, and late homework will not be accepted. Announced and/or unannounced quizzes may be given, and there may be assignments completed and collected during class. Students are expected to be present for class, and missed quizzes or classwork may not be completed for credit. The lowest 2 scores in the homework/classwork/quiz category will be dropped.

A significant part of doing mathematics is *communicating* mathematics. Homework is expected to be clear and grammatically correct, in addition to mathematically accurate. Homework not meeting this criteria may be returned ungraded.

You are encouraged to work together, but submitted written assignments must be your own work and represent your own understanding. **You should not search for, read, or submit any solutions or partial solutions obtained from the internet**. If you need clarification on this policy, please ask.

Exams.

There will be two midterms exams and a final exam. Exam 1 is *tentatively* scheduled for Monday, February 28. Exam 2 is *tentatively* scheduled for Wednesday, April 6. The **final exam** is scheduled by the University for: Tuesday, May 17 from 2:15 pm to 5:00 pm. Other arrangements will be made for those students who are currently teaching in 7-12 schools.

0.2. **Final Grades.** Your final grades will be based on the following:

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

Your grades will be no lower than as determined by the following:

- A: 88%
- B: 76%
- C: 64%
- F: Below 64%

0.3. **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. [The] faculty is 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`

Submitting solutions obtained from the internet is submitting someone else's work as your own; to do so is a violation of the policy on academic integrity.

If you do not understand the policy on academic integrity, please ask for clarification.

0.4. **Student Accessibility Support Center Statement:** If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631) 632-6748. They will determine with you what accommodations, If any, are necessary and appropriate. All information and documentation is confidential.

`https://www.stonybrook.edu/commcms/studentaffairs/sasc/current_students/accommodation.php`

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website:

`http://www.stonybrook.edu/ehs/fire/disabilities`

0.5. **Critical Incident Management.** Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty [members] are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most

academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

0.6. **Learning Outcomes.**

- Students describe the classical number systems used in high school (natural numbers, integers, rational, real and complex numbers) and relations among them.
- Students formulate and use the basic properties of algebraic operations (associativity, commutativity, distributivity).
- Students define basic algebraic structures such as groups, rings, and fields; and they recognize these structures in appropriate situations.
- Students define homomorphisms and isomorphisms and determine when a map meets these definitions.
- Students demonstrate their understanding of divisibility, divisor, greatest common divisor, prime, irreducible in the integers, and they extend this understanding to the ring of polynomials and to other rings.
- 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.
- Students use the Euclidean algorithm to determine a greatest common divisor.
- Students study and solve linear Diophantine equations.
- Students perform basic operations with congruence classes and identify congruence classes as elements of a residue ring.
- Students apply their understanding of modular arithmetic to study Diophantine equations.
- Students determine units in a ring.
- Students define the Euler function and formulate and prove properties of this function.
- 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.
- Students define zero divisor and integral domain.
- Students solve linear equations in residue rings.
- Students prove that polynomials with coefficients in a ring form a ring.
- Students define ideal in a ring, kernel of a ring homomorphism, quotient ring.
- Students interpret the simplest algebraic extension of fields as quotient rings of the polynomial ring over the field.
- Students express a symmetric polynomial as a product of elementary symmetric polynomials; students use this expression in problem solving.
- Students formulate and prove Vieta's formulas.
- Students give an example of a ring that is not a unique factorization domain.