

# SOUTHEAST MISSOURI STATE UNIVERSITY

Department of Mathematics  
Title of Course: Rings and Modules

Course Number: MA644  
Date: January 2011

**I. Catalog Description:** Rings, Ideals, Quotient Rings, Domains, Polynomial Rings, Modules, Modules over PIDs, Commutative Rings. (3)

**II. Prerequisites:** MA445 Modern Algebra

### III. Objectives of Course:

To acquaint the students with the modern algebraic theory of rings and modules. To introduce the students to the basics of commutative algebra in preparation for further study in algebra, geometry or number theory.

### IV. Expectations of Students:

The students are expected to participate in classroom activities, do homework, and be able to write proofs.

### V. Course Outline: (# class hours)

- A. Introduction to Rings – (11)
  - 1. Basic Definitions and Examples
  - 2. Polynomial Rings, Matrix Rings and Group Rings
  - 3. Ring Homomorphisms and Quotient Rings
  - 4. Properties of Ideals
  - 5. Rings of Fractions
  - 6. Chinese Remainder Theorem
- B. Euclidean Domains, Principal Ideal Domains and Unique Factorization Domains – (6)
- C. Polynomial Rings – (6)
  - 1. Definitions
  - 2. Polynomial Rings over Fields
  - 3. Polynomial Rings that are UFDs
  - 4. Irreducibility Criteria
- D. Module Theory – (9)
  - 1. Definitions
  - 2. Quotient Modules and Module Homomorphisms
  - 3. Generation of Modules, Direct Sums and Free Modules
  - 4. Tensor Products of Modules (optional)
  - 5. Short Exact Sequences
  - 6. Projective, Injective, and Flat Modules (optional)
- E. Modules over PIDs – (3)
- F. Commutative Rings and Algebraic Geometry – (8)
  - 1. Noetherian Rings and Affine Algebraic Sets
  - 2. Radicals and Affine Varieties
  - 3. Integral Extensions and Hilbert's Nullstellensatz
  - 4. Localization (optional)
  - 5. Artinian Rings (optional)
- G. Examinations (2)

Total Class Hours: 45

**VI. Textbook:** Dummit and Foote. *Abstract Algebra*, 3<sup>rd</sup> Edition. Wiley, 2003.

### VII. Basis of Student Evaluation:

A. Assignments	60%
B. Hourly Exams	20%
C. Final Exam	20%

### **VIII. Grading Scale**

90% - 100% = A

80% - 89% = B

70% - 79% = C

0% - 69% = F

The weight of the evaluation criteria may vary according to each instructor and will be communicated at the beginning of the course.

### **IX. Academic Policy Statement:**

Students will be expected to abide by the University Policy for Academic Honesty regarding plagiarism and academic honesty. Refer to:

<http://www6.semo.edu/judaffairs/code.html>

### **X. Student with Disabilities Statement:**

If a student has a special need addressed by the Americans with Disabilities Act (ADA) and requires materials in an alternative format, please notify the instructor at the beginning of the course. Reasonable efforts will be made to accommodate special needs.