Math 111: Abstract algebra

ORC syllabus

This course provides a second course in abstract algebra, involving the theory of rings and fields with the topic alternating between years. The study of fields begins with polynomial rings, finite and algebraic extensions of fields, and builds to the fundamental theorem of Galois theory, with applications. A course in commutative algebra includes an introduction to (commutative) rings, modules over rings, and the beginnings of algebraic geometry.

References.

[DF] David Dummit and Richard Foote, *Abstract algebra*, 3rd ed., John Wiley and Sons, 2004.

***Possible topic*: Galois theory.**

1. Fundamentals of polynomial rings. Factorization criteria. [DF, 9.1–9.5]
2. Field extensions. Algebraic extensions. Straightedge and compass constructions. Splitting fields and algebraic closures. Separable and inseparable extensions. Cyclotomic polynomials and extensions. [DF, 13.1–13.6]
3. Galois theory. Finite Fields. Composite and simple extensions. Cyclotomic and abelian extensions. Galois groups of polynomials. Solvable and radical extensions. Insolvability of the quintic. Computation of Galois groups over the rationals. Transcendental extensions, infinite Galois groups. [DF, 14.1–14.9]

***Possible topic*: Commutative algebra.**

1. Fundamentals of module theory. [DF, 10.1–10.3]
2. Modules over PIDs. Fundamental theorem. Elementary divisors and invariant factors. Rational canonical form. Jordan canonical form. [DF, 12.1–12.3]
3. Tensor products. Exact sequences. Categories and functors. Projective, injective, and flat modules. [DF, 10.4–10.5]
4. Affine algebraic sets. Affine varieties. Integral extensions and Hilbert's Nullstellensatz. Localization. The prime spectrum of a ring. [DF, 15.1–15.5]
5. Artinian rings. DVRs. Dedekind domains. [DF, 16.1–16.3]