Syllabus

Math 6112 – Abstract Algebra II
Lecture: 11:30 MWF – 1064 Smith Lab
Recitations: 11:30 TTh – 2006 Smith Lab
Spring 2020

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Suggested text: N. Jacobson, *Basic Algebra II*. Dover 2009; E. Artin, *Galois Theory*, Notre Dame Mathematical Lectures No. 2, 1942.

The Jacobson books *Basic Algebra I & II* are available on Dover and so are relatively inexpensive. The Artin notes are now available for free on Project Euclid.

Content: This is the second semester of the PhD level abstract algebra sequence. It is part of the qualifying exam system. To receive credit for the course as part of the qualifying exam structure, you must receive an A- or better.

The current syllabus for the course is:

Category Theory: categories, dual categories, universal objects; covariant and contravariant functors; representable functors, natural transformations; products and coproducts; inverse limits and direct limits; free abelian groups, free groups, generators and relations. (BAII, Chapter 1, §1–7, Chapter 2, §5)

The Category of Modules: modules, homomorphisms, the *Hom* functor, direct products and direct sums of modules; free modules, projective and injective modules, tensor products. (BAII Chapter 3, §1, 7, 10, 11)

Homological Algebra: additive and abelian categories, complexes, homology & cohomology sequence, the snake lemma; projective and injective resolutions, derived functors, *Ext* and *Tor*. (BAII Chapter 6, §1 – 8)

Basic Fields Theory: (Review?) algebraic extensions, splitting fields, normal extensions, separability; Galois theory for finite extensions, finite fields, perfect fields. (Artin, Chapter II, §A – I)

Advanced Field Theory: cyclotomic extensions, independence of characters, Kummer extensions, radical extensions, solvable extensions, simple extensions and normal bases; algebraic closure, separable and inseparable extensions, Galois theory for infinite extensions, transcendental extensions. (Artin, Chapter II, §J – N; BA II, Chapter 8, §1, 6, 7, 9, 12, 13)

Class structure: First, I expect attendance. We will hold regular lecture/discussion format class 3 days a week, Monday, Wednesday, and Friday. Recitations with Edmonds will be on Tuesday and Thursday.

Assignments: I will assign and collect homework weekly. If this is to work, both for you and for me, you must get your assignments in on time. You are encouraged to work together, but *your write ups must be your own.* Homework will account for 25% of your grade.

Exams: There will be two exams, one during the semester and one during the final exam period. The Midterm will be worth 25% of your grade and the Final is worth 50%.

> Midterm Exam: Friday, March 6, in class.
> Final Exam: Friday, April 24, 12:00 – 1:45.

The grade: To compute the final grade, I will start with the usual scale:

90% - 100% : A range

80% - 89% : B range

70% - 79% : C range

60% - 69% : D range

0% - 59% : potential E

but I would expect that some curving will be in order.

Note: Any of the above is subject to change if the structure is not working out for us.

Supplemental Texts: Here are some supplemental texts that are used in classes at this level. For my taste, however, few write better than Jacobson and Artin.

- P. Freyd, *Abelian Categories*, Harpers,1964.
- S. Lang, *Algebra*, Springer GTM 211, 2002.
- S. MacLane, *Categories for the Working Mathematician*, Springer GTM 5, 1972.
- J. Rotman, *An Introduction to Homologicl Algebra*, Springer Universitext, 2009.
- C. Weibel, *An Introduction to Homological Algebra*, Cambridge Studies in Advanced Math. **38**, CUP, 1994.