Algebra Qualifying Exam Syllabus
UW Pure Math

October 31, 2025

Below are the calendar descriptions for the courses the algebra qualifying exam is based on. They are not absolutely comprehensive, but give the high level topics that will be covered in the qualifying exam.

Linear Algebra (MATH 245)

Orthogonal and unitary matrices and transformations. Orthogonal projections, Gram-Schmidt procedure, best approximations, least-squares. Inner products, angles and orthogonality, orthogonal diagonalization, singular value decomposition, applications.

Groups and Rings (PMATH 347)

Groups, subgroups, homomorphisms and quotient groups, isomorphism theorems, group actions, Cayley and Lagrange theorems, permutation groups, Sylow theorems, and the fundamental theorem of finite abelian groups. Elementary properties of rings, subrings, ideals, homomorphisms and quotients, isomorphism theorems, and polynomial rings.

Fields and Galois Theory (PMATH 348)

Unique factorization domains, Gauss's lemma, and Eisenstein's criterion. Fields, algebraic and transcendental extensions, minimal polynomials, splitting fields, and the structure of finite fields. Galois theory. Solvable groups and the insolvability of the quintic.

References

[1] M. Artin, *Algebra*, Prentice Hall, Englewood Cliffs, NJ, 1991; MR1129886

[2] D. S. Dummit and R. M. Foote, *Abstract algebra*, third edition, Wiley, Hoboken, NJ, 2004; MR2286236

[3] T. W. Hungerford, *Algebra*, reprint of the 1974 original, Graduate Texts in Mathematics, 73, Springer, New York-Berlin, 1980; MR0600654

[4] J. J. Rotman, *Advanced modern algebra*, second edition Graduate Studies in Mathematics, 114, Amer. Math. Soc., Providence, RI, 2010; MR2674831