Proposed topics for the Ph. D. Qualifying Oral Examination
Candidate : Jooyoun Hong
Committee : Barbara Osofsky, Charles Weibel and Wolmer Vasconcelos

Commutative Algebra

1. Basic Commutative Algebra

1.1   Localization of rings and modules
1.2   The Hilbert Nullstellensatz
1.3   Associated primes and primary decomposition
1.4   Integral dependence and valuations
1.5   DVRs, Dedekind rings, and Krull rings
1.6   Chain Conditions
1.7   Noetherian and Artinian rings
1.8   Completions

2. Hilbert Functions of Graded Modules

2.1   Graded rings and modules
2.2   Hilbert functions over homogeneous rings
2.3   Macaulay's theorem on Hilbert functions
2.4   Gotzmann's regularity and persistence theorem
2.5   Hilbert functions over graded rings
2.6   Filtered rings
2.7   The Hilbert-Samuel function and reduction ideals
2.8   Multiplicity

3. Cohen-Macaulay Rings

3.1   Regular sequences
3.2   Grade and depth
3.3   Depth and projective dimension
3.4   Cohen-Macaulay rings and modules
3.5   Regular rings and normal rings
3.6   Complete intersections

Homological Algebra and Gröbner Bases

1. Homological Algebra

2. Gröbner Bases

References

[1] M.F. Atiyah and I.G. Macdonald, *Introduction to Commutative Algebra*, Addison-Wesley, 1969

[2] W. Bruns and J. Herzog, *Cohen-Macaulay Rings*, Cambridge University Press, 1993

[3] H. Matsumura, *Commutative Ring Theory*, Cambridge University Press, 1986

[4] W.W. Adams and P. Loustaunau, *An Introduction to Gröbner Bases*, AMS, 1994

[5] D. Cox, J. Little, and D. O'Shea, *Ideals, Varieties and Algorithms* , Springer-Verlag, 2nd edition, 1997

[6] J.J. Rotman, *An Introduction to Homological Algebra*, Academic Press, 1979

[7] W.V. Vasconcelos, *Computational Methods in Commutative Algebra and Algebraic Geometry*, Springer-Verlag, 1998

[8] C.A. Weibel, *An Introduction to Homological Algebra*, Cambridge University Press, 1994