

# DEPARTMENT OF MATHEMATICS

## ORAL EXAMINATION

### Major area: HOMOLOGICAL ALGEBRAS

- I. Ext
  1. Complexes
  2. Projective resolution, injective coresolution, enough projectives
  3. Homology: definition of Ext, Tor
  4. Ext as a functor of two variables
  5. Relative Ext
  
- II. Yoneda theory
  1. n-extensions
  2. Definition of Yext
  3. Yext is Ext
  4. Relative cohomology
  
- III. Triples and cotriples
  1. Definition of triple & cotriple
  2. Triples, cotriples from adjoint functors
  3. Examples
  4. Cotriples & homology
  5. Example: R-Mod
  6. Cotriples & relative cohomology
  7. Cotriples & Yoneda theory
  8. Cotriple definition of projective and free
  9. Acyclic models
  
- IV. Derived categories and homology
  1. Triangulated categories
  2. Additive systems
  3. Localized category
  4. Homology
  5. Way-out functors
  
- V. Deformation Theory
  1. Definition of deformation of an algebra
  2. Definition of algebraic map
  3.  $H^2(A;A)$  and deformation of A
  4. Obstructions
  5. Deformation formulas
  
- VI. Algebras of finite Representation Type.

- References:** Rotman: Homological Algebra  
MacLane: Categories for the Working Mathematician (Ch 1-4,6,8)  
Iverson: Cohomology of Sheaves (Ch. 11)  
Hartshorne: Residues and Dualities (Ch. 1)  
Barr & Beck: Homology and Standard Constructions Acyclic models and triples  
Gerstenhaber & Schack: Algebraic Cohomology and Deformation Theory (Ch. 1,3-5)  
Pierce: Associative Algebras (Ch.7)