

Oral qual syllabus

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1 Algebraic geometry

1.1 Sheaves and schemes

- Presheaves, sheaves
- Schemes
- Morphisms of schemes—separated, proper, projective, flat, étale
- Sheaves of modules; quasicohherent and coherent sheaves
- Invertible sheaves; divisors—Weil and Cartier
- Differentials

1.2 Cohomology

- Cohomology of noetherian affine schemes
- Cohomology of projective space
- Ext groups and sheaves
- Serre duality

1.3 Curves

- Riemann-Roch
- Hurwitz's theorem
- Embeddings into projective space

2 Homological algebra

2.1 Derived functors

- δ -functors
- Left and right derived functors
- Adjoint pairs and left/right exactness
- Balancing Tor and Ext

2.2 Examples

- Tor; relation to flatness
- Ext; relation to extensions
- Sheaf cohomology
- Čech cohomology
- Higher direct images $R^q f_*$

2.3 Spectral sequences

- Convergence theorems
- Hyperhomology
- Grothendieck spectral sequences

3 References

Hartshorne, *Algebraic Geometry*

Mumford, *Introduction to Algebraic Geometry*

Weibel, *An Introduction to Homological Algebra*