

Homological Algebra

Non-Examinable (Graduate Level)

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To the best of our knowledge, this is the first time this fundamental course has been offered as a Part III course in Cambridge.

Although non-examinable, Homological Algebra is essential for those students who are interested in pursuing a PhD in algebraic geometry, in particular, in the areas that use the language of derived categories, such as “enumerative algebraic geometry”, “moduli of sheaves”, “stability conditions”, and “mirror symmetry”, to name a few.

The course will cover a selection of topics such as:

- Exact sequences and chain complexes
- Abelian categories
- Derived functors, Ext and Tor
- Basic derived and triangulated categories
- Semi-orthogonal decompositions
- If time permits, an introduction to stability conditions

Prerequisites

Part III commutative algebra and basic sheaf theory (Part III algebraic geometry) will be helpful.

Literature

1. Charles A. Weibel, *An Introduction to Homological Algebra*. Cambridge University Press, 1996.
2. Peter J. Hilton, and U. Stammbach, *A Course in Homological Algebra*. Graduate Texts in Mathematics, 4, 1997.
3. Sergei I. Gelfand, and Yuri I. Manin, *Methods of Homological Algebra*. Springer Monographs in Mathematics, 2002.
4. D. Huybrechts, *Fourier-Mukai Transforms in Algebraic Geometry*. Oxford Mathematical Monographs, 2006.
5. A. Kuznetsov, *Semiorthogonal decompositions in algebraic geometry*. arXiv:1404.3143.
6. A. Bayer, *A tour to stability conditions on derived categories*. <https://webhomes.maths.ed.ac.uk/~abayer/dc-lecture-notes.pdf>

Additional support

Some steps in the course will be left as exercises. These will not have accompanying solutions or be graded, but you are encouraged to give them a try and accompanying office hours will be offered.