PRE-RESQUISITES

Mantra:

> Let us face it. You cannot read most of the current literature on algebraic geometry without knowing sheaf theory ...
>
> Goerge Kempf [K1, Chapter 4]

Pre-requisites and co-requisites. In the list(s) given below, you don't have to know all the proofs. You should know definitions and statements of theorems. It is fine if you don't know many of the topics before classes begin. The instructors will let you know what you will need in the weeks to come. But you will do well to look up what you can now. The lists are not exhaustive. Other topics will be added to it likely as the course goes ahead.

Commutative Algebra. The texts in the bibliography are a good reference. Some of the topics will be quickly reviewed. And there may homework problems (which will not be too difficult) to help you with the concepts as we go along in the course.

1. Definition of Spec R as a topological space for a commutative ring R. Definition of noetherian and artinian rings and modules.
2. Free, projective and injective modules.
3. Tensor products and flat modules.
4. Krull dimension.
5. Primary Decomposition of modules.
6. Noether normalisation, Hilbert's nullstellensatz.
7. Regular sequences, M-sequences, Cohen-Macaulay rings and modules.

Category Theory and Homological Algebra. For the topics in the list below, the material in https://www.cmi.ac.in/~pramath/teaching.html#GalgI may help, especially the notes, to get at definitions, and if you have time, proofs. You may have to look at Homework problems for that course if you wish to complete some proofs in the notes (depending on the amount of time you have). Also look at [M, Appendix B], but remember to convert chain complexes to co-chain complexes by the rule that a chain complex $C_\bullet$ corresponds to a co-chain complex $D^\bullet$ where the two complexes are related via the rule $C_i = D^{-i}$.

8. Abelian Categories.
9. Direct and inverse limits in abelian categories.
10. Complexes and their cohomologies on abelian categories.
11. Quasi-isomorphisms and mapping cones: See https://www.cmi.ac.in/~pramath/AGI/notes/MappingConesEtc.pdf.
12. Derived functors on abelian categories via injective and projective resolutions, Ext^i, Tor_i.
13. Double complexes: See https://www.cmi.ac.in/~pramath/AGI/notes/dblecmplx.pdf.

References

[AM] M.F. Atiyah and I.G. MacDonald, *Introduction to Commutative Algebra*, Addison-Wesley, 1994.

[K1] G.R. Kempf, *Algebraic Varieties*, LMS Lecture Notes Series 172, Cambridge University Press, Cambridge UK, 1993.

[1] E. Kunz, *Introduction to Commutative Algebra and Algebraic Geometry*, Birkauser, 1985.

[M] H. Matsumura, *Commutative Ring theory*, Cambridge studies in advanced mathematics 8, Cambridge University Press, Cambridge, 1980.

[St] The Stacks Project Authors, *Stacks Project*, https://stacks.math.columbia.edu, 2018