ALGEBRAIC GEOMETRY 2022–2023

	DAY	TIME	WHERE	TYPE	TOPICS
LECTURE 1	11 October 2022	16:00 - 18:00	Room 134 (SISSA)	Theory	Presheaves, sheaves, morphisms, constant presheaves, sheaf condition via equalisers.
LECTURE 2	13 October 2022	16:00 - 18:00	Room 134 (SISSA)	Theory	Stalks, compatible germs. Surjectivity of maps of sheaves. Characterisation of isomorphisms via stalks (proof). Existence of sheafification (proof).
LECTURE 3	18 October 2022	9:00 - 11:00	Room 136 (SISSA)	Theory	Skyscrapers. Exact sequences of sheaves. Defining sheaves on basic open sets. Direct image sheaf. Supports of sheaves and sections.
LECTURE 4	18 October 2022	16:00 - 18:00	Room 128 (SISSA)	Theory	Inverse image sheaf and the adjunction with direct image. Locally ringed spaces, their morphisms. Closed immersions = ideal sheaves.
LECTURE 5	20 October 2022	16:00 - 18:00	Room 137 (SISSA)	Theory	Spectrum of a ring, Zariski topology. Closed points. First examples of Spec(A).
LECTURE 6	25 October 2022	9:00 - 11:00	Room 136 (SISSA)	Theory	Localisation of a module. Structure sheaf of Spec(A). Definition of affine schemes. Schemes. Quasicompact, connected, irreducible schemes.
LECTURE 7	25 October 2022	16:00 - 18:00	Room 005 (SISSA)	Exercises	Local ring of Spec(A) at at prime ideal. Connectedness and idempotents. Localisation. Residue field of local ring at a maximal ideal of a ring.
LECTURE 8	27 October 2022	16:00 - 18:00	Room 005 (SISSA)	Theory	Definition of affine schemes and schemes. Morphisms of affine schemes. Spec is an equivalence Rings^op —> Aff.
LECTURE 9	8 November 2022	9:00 - 11:00	Room 136 (SISSA)	Theory	More on structure sheaf of Spec(A). Irreducible schemes have a unique generic point. Examples of affine (and not affine) schemes and morphisms.
LECTURE 10	8 November 2022	16:00 - 18:00	Room 005 (SISSA)	Theory	Schemes over a base. Hom(-,Y) is a sheaf. Morphisms to an affine scheme (adjunction). Glueing schemes (no proof). Projective space over a ring.
LECTURE 11	10 November 2022	16:00 - 18:00	Room 005 (SISSA)	Theory	Proj of a graded A-algebra and its scheme structure. Second definition of projective space. Projective A-schemes. Projective varieties
LECTURE 12	15 November 2022	16:00 - 18:00	Room 005 (SISSA)	Exercises	The rational normal curve in P^e. Veronese embedding. Plane conics, twisted cubic.
LECTURE 13	22 November 2022	16:00 - 18:00	Room 134 (SISSA)	Theory	More on the twisted cubic. (De)homogeneisation. Affine cones. Irreducible components. Locality lemma. Noetherian schemes. Examples.
LECTURE 14	24 November 2022	16:00 - 18:00	Room 134 (SISSA)	Theory	Reducedness is a local property. Reduced schemes. Reduced induced closed subscheme structure. Integral scheme = reduced + irreducible.
LECTURE 15	29 November 2022	9:00 - 11:00	Room 136 (SISSA)	Theory	Dimension of schemes and rings and main properties. Dimension theory for varieties. Krull's theorem (no proof) and consequences
LECTURE 16	29 November 2022	16:00 - 18:00	Room 005 (SISSA)	Theory	Base change. Properties stable under base change, local on the target. The diagonal. Separated morphisms. Affine morphisms are separated.
LECTURE 17	1 December 2022	16:00 - 18:00	Room 005 (SISSA)	Exercises	Affine and projective dimension theorems. Dimension of fibres. There are no morphisms P^n —> P^1 if n > 1.
LECTURE 18	6 December 2022	16:00 - 18:00	Room 134 (SISSA)	Theory	Morphisms: (locally) finite type, (quasi)separated, proper. Criteria for separatedness. Valuative criteria (no proof). Functions on proper k-schemes.
LECTURE 19	13 December 2022	16:00 - 18:00	Room 005 (SISSA)	Theory	Regular schemes. Jacobian criterion. Flat, smooth, unramified, étale morphisms. Infinitesimal lifting criterion with examples.
LECTURE 20	15 December 2022	16:00 - 18:00	Room 005 (SISSA)	Theory	O_X-modules, (quasi)coherent sheaves on affine and projective schemes. Maps to P^n_A as invertible sheaves + generating sections.
LECTURE 21	20 December 2022	16:00 - 18:00	Room 005 (SISSA)	Exercises	Exercises on coherent sheaves and locally free sheaves.
LECTURE 22	10 January 2023	16:00 - 18:00	Room 005 (SISSA)	Theory	Weil and Cartier divisors. Relation with the Picard group.
LECTURE 23	11 January 2023	14:00 - 16:00	Room 136 (SISSA)	Exercises	Blowups: definitions, main properties. Blowup of zero section of affine space over a ring.
LECTURE 24	12 January 2023	16:00 - 18:00	Room 005 (SISSA)	Exercises	Blowups: more examples. 3 points in P^2. Intersection form on a surface (axiomatically) -> E^2 = -1 formula and consequences.
LECTURE 25 (PHD)	17 January 2023	16:00 - 18:00	Room 005 (SISSA)	Theory	Cohomology of sheaves via injective resolutions. Flasque sheaves. Grothendieck's theorem on vanishing of H* above the Krull dimension.
LECTURE 26 (PHD)	19 January 2023	16:00 - 18:00	Room 005 (SISSA)	Theory	Projective morphisms. Serre's theorems: affine schemes and vanishing cohomology. Cohomology of projective schemes. Genus-degree formula (proof).
LECTURE 27 (PHD)	24 January 2023	16:00 - 18:00	Room 205 (IGAP)	Theory	The relative cotangent sheaf. Characterisation of smoothness via the conormal exact sequence (no proof). Examples.
LECTURE 28 (PHD)	26 January 2023	16:00 - 18:00	Room 005 (SISSA)	Theory	Ext. Serre duality on P^n. Dualising sheaf. Serre duality for smooth projective varieties. Canonical bundle of hypersurfaces. Deg = 2g-2 for plane curves
LECTURE 29 (PHD)	31 January 2023	16:00 - 18:00	Room 205 (IGAP)	Theory	Curves I: Riemann-Roch, special divisors, examples. Riemann-Hurwitz formula. P^1 is simply connected.
LECTURE 30 (PHD)	2 February 2023	16:00 - 18:00	Room 005 (SISSA)	Theory	Statement of cohomology and base change, and applications. Sketch of the construction of the moduli space of curves.