BEN GURION UNIVERSITY **אוניברסיטת בן גוריון בנגב**

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פרופ' אמנון יקותיאלי
המחלקה למתמטיקה
אוניברסיטת בן גוריון
באר שבע 84105

30 August 2018

Algebraic Geometry – Schemes (1)

BGU, Fall 2018-19

201.2.0121

The course will be in English. It will continue in the Spring semester, as "Algebraic Geometry – Schemes (2)"

Course web site (with up-to-date information):
https://www.math.bgu.ac.il/~amyekut/teaching/2018-19/schemes-1/course_page.html

Prerequisites and Level. The course is intended for graduate students and advanced undergraduate students.

Participants of the course should have familiarity with most of these topics: introduction to algebraic geometry (varieties over an algebraically closed field, or at least algebraic curves); commutative algebra; homological algebra; algebraic topology; and differentiable or complex analytic manifolds.

The level of the course course will be calibrated – in terms of sophistication of the presentation – to the audience, under the assumption that they had already learned much of the material listed above.

Please send me an email if you are considering attending the course, indicating which of the topics above you had learned (in a formal course or privately), your academic status (degree and year), and whether you intend to register or just to listen.

Course Topics : (tentative, for both semesters)

1. **Sheaves on topological spaces**. Definitions and examples. Sheaves of groups, torsors. Gluing (descent), cocycles and sheaf cohomology. Operations on sheaves. Monodromy. Relations with algebraic topology.
2. **Ringed spaces**. Definitions. Examples from differential and analytic geometry. Locally ringed spaces. Locally free sheaves, vector bundles, Picard group. Finiteness properties.
3. **Affine Schemes**. Definitions and basic properties. Morphisms. Examples from arithmetic.
4. **Schemes**. Definitions and basic properties. Closed and open subschemes. Noetherian and quasi-compact schemes. Coherent and quasi-coherent sheaves.
5. **Maps of schemes**. Fiber products and base change. Finite, finite type, flat, separated, proper and projective maps.
6. **Maps to projective space and blow-ups.** Definitions and examples. Computing the Picard group of the projective space $\mathbf{P}^n$.

7. **Calculating some invariants**. Sheaf cohomology, genus, etc.
8. **The functor of points and moduli spaces**.
9. **Algebraic differential calculus**. Smooth morphisms, differential forms, etc.
10. **Group schemes and their Lie algebras**.

Bibliography:

1. Hartshorne, *Algebraic Geometry*, Springer.
2. Eisenbud and Harris, *The Geometry of Schemes*, Springer.
3. Olsson, *Algebraic Spaces and Stacks,* AMS.
4. Kashiwara and Schapira, Sheaves on Manifolds, Springer.
5. de Jong (Ed.), *The Stacks Project,* online
6. Course lecture notes (to be posted weekly).