

## המחלקה למתמטיקה

סמסטר 2020-21 א

שם הקורס גיאומטריה אלגברית - סכמות - 1

מספר קורס 201.2.0121

עמוד הקורס ברשת

[https://www.math.bgu.ac.il/~amyekut/teaching/2020-21/schemes-1/course\\_page.html](https://www.math.bgu.ac.il/~amyekut/teaching/2020-21/schemes-1/course_page.html)

מרצה אחראי פרופ' אמנון יקותיאלי, <amyekut@bgu.ac.il>, חדר 202

שעות קבלה <https://math.bgu.ac.il/he/teaching/hours>

### תקציר

See details for page web course  
Please email me if you want to attend (even just for the first or two lectures),  
I will send you the "taste" to the course). zoom link.

### דרישות והרכב ציון הקורס<sup>1</sup>

See details for page web course  
Please email me if you want to attend (even just for the first or two lectures),  
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<sup>1</sup>דרישות יכולות להשתנות במהלך השבועיים הראשונים של הסמסטר, ויש לשים לב להודעות באתר הקורס



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

10 September 2020

## Algebraic Geometry – Schemes 1

BGU, Fall 2020-21

Catalogue no. 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/2020-21/schemes-1/course\\_page.html](https://www.math.bgu.ac.il/~amyekut/teaching/2020-21/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 – ideally – familiarity with most of these topics: categories and functors, 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 will be calibrated – in terms of rate of progress and 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 have 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. **Categories and functors.** Definitions and examples. Natural transformations.
2. **Sheaves on topological spaces.** Sheaves of functions on topological spaces. Definitions and examples (sheaves of sets, abelian group, etc.). Stalks. Sheafification. Gluing (descent), cocycles and 1-st nonabelian cohomology. Operations on sheaves.
3. **Ringed spaces.** Definitions. Examples from differential and analytic geometry. Locally ringed spaces. Locally free sheaves, vector bundles, Picard group. Finiteness properties.
4. **Affine Schemes.** Definitions and basic properties. Morphisms. Examples from arithmetic.
5. **Schemes.** Definitions and basic properties. Closed and open subschemes. Noetherian and quasi-compact schemes. Coherent and quasi-coherent sheaves.

6. **Maps of schemes.** Fiber products and base change. Finite, finite type, flat, separated, proper and projective maps.
7. **Maps to projective space and blow-ups.** Definitions and examples. Computing the Picard group of the projective space  $\mathbf{P}^n$ .
8. **Calculating some invariants.** Sheaf cohomology, genus, etc.
9. **The functor of points and moduli spaces.**
10. **Algebraic differential calculus.** Smooth morphisms, differential forms, etc.
11. **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).



## נושאי לימוד

1. אלומות (sheaves) על מרחבים טופולוגיים.
2. סכמות אפיניות (affine schemes).
3. סכמות ומורפיזמים ביניהן.
4. אלומות קוואזי-קוהרנטיות.
5. מורפיזמים מופרדים (separated) ומורפיזמים נאותים (proper).
6. אגדים וקטוריים (vector bundles) וחבורת פיקאר (Picard) של סכמה.
7. פונקטור הנקודות (functor) of (points ומרחבי מודולים moduli spaces).
8. מורפיזמים למרחב הפרוייקטיבי ופיצוצים (blow-ups).
9. מורפיזמים חלקים (smooth morphisms) ותבניות דיפרנציאליות (differential forms).
10. קוהומונולוגיה של אלומות (sheaf cohomology).
11. סכמות חבורה (group schemes).