

## המחלקה למתמטיקה

סמסטר 22-2021-א

שם הקורס אלגברה הומוטופית

מספר קורס 201.2.2091

עמוד הקורס ברשת

[https://math.bgu.ac.il/~amyekut/teaching/2021-22/homol-alg/course\\_page.html](https://math.bgu.ac.il/~amyekut/teaching/2021-22/homol-alg/course_page.html)

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

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

### תקציר

permits) time as much (as Topics: Course

1. noncommutative (including modules and ideals rings, On material. prior of Review rings).

2. be will topic (This categories. linear on Emphasis functors. and Categories along.) go we as gradually, introduced

3. polynomial sums, direct products, modules, Free constructions. Universal rings.

4. properties. and construction Definition, products. Tensor

5. functors. and sequences Exact Exactness.

6. modules. flat and injective Projective, modules. Special

7. long the homotopies, complexes, on Operations modules. of Complexes sequence. cohomology exact

8. resolutions. injective and flat Projective, Resolutions.

9. algebra. commutative to Applications functors. derived right and Left

10. extensions. problems, Classification functors. derived of applications Further

11. Theory. Morita



”Commutative course subsequent the to move might material the of (Some  
Algebra“)

<sup>1</sup>page web course the see requirements course and syllabus updated an For

<sup>2</sup>דרישות והרכב ציון הקורס

<sup>3</sup>page web course see

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<sup>1</sup>[https://www.math.bgu.ac.il/~amyekut/teaching/2021-22/homol-alg/course\\_page.html](https://www.math.bgu.ac.il/~amyekut/teaching/2021-22/homol-alg/course_page.html)

<sup>2</sup>דרישות הקורס יכולות להשתנות במהלך השבועיים הראשונים של הסמסטר, ויש לשים לב להודעות באתר הקורס

<sup>3</sup>[https://www.math.bgu.ac.il/~amyekut/teaching/2021-22/homol-alg/course\\_page.html](https://www.math.bgu.ac.il/~amyekut/teaching/2021-22/homol-alg/course_page.html)

syllabus – new plan

7 June 2021

Amnon Yekutieli

# Homological Algebra

Fall Semester 2021-22

*Catalog Number:* 201.2.2091

*Prerequisites:*

1. Algebraic Structures
2. Introduction to Topology

*Recommended:*

1. Introduction to Commutative Algebra
2. Introduction to Algebraic Geometry
3. Basic Concepts in Topology and Geometry

*Course Topics:* (as much as time permits)

1. **Review of prior material.** On rings, ideals and modules (including noncommutative rings).
2. **Categories and functors.** Emphasis on linear categories. (This topic will be introduced gradually, as we go along.)
3. **Universal constructions.** Free modules, products, direct sums, polynomial rings.
4. **Tensor products.** Definition, construction and properties.
5. **Exactness.** Exact sequences and functors.
6. **Special modules.** Projective, injective and flat modules.
7. **Complexes of modules.** Operations on complexes, homotopies, the long exact cohomology sequence.
8. **Resolutions.** Projective, flat and injective resolutions.
9. **Left and right derived functors.** Applications to commutative algebra.
10. **Further applications of derived functors.** Classification problems, extensions.
11. **Morita Theory.**

(Some of the material might move to the subsequent course "Commutative Algebra")

## נושאי לימוד

- .1 modules ideals, noncommutative), (including Rings material. prior Recalling tensor products, and sums direct infinite sequences, exact bimodules, and rings. and modules of products
- .2 categories Linear equivalences. functors, of Morphisms functors. and Categories functors. of Exactness functors. linear and
- .3 modules. flat and injective Projective, modules. Special
- .4 products. tensor as realized categories module of Equivalences Theory. Morita
- .5 long the homotopies, complexes, on Operations modules. of Complexes sequence. cohomology exact
- .6 uniqueness. and existence – resolutions flat and injective Projective, Resolutions.
- .7 functors. Ext and Tor theory. general The functors. derived right and Left
- .8 involving theorems, global and local Some algebra. commutative to Applications functors. torsion and completion Derived functors. *Ext* and *Tor*
- .9 geometry. in algebra homological of role the of survey A cohomology. Sheaf
- .10 cohomology, Galois theorems: classification of survey A cohomology. Nonabelian bundles. vector

## Bibliography

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- .1990 Springer, Manfolds, on Sheaves Schapira, P. and Kashiwara M. .7

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web course the to week every uploaded be to notes, Course (10) .<sup>5</sup>version  
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<sup>4</sup><http://stacks.math.columbia.edu>

<sup>5</sup><https://arxiv.org/abs/1610.09640v4>