אוניברסיטת
בן-גוריון בנגב

The Department of Mathematics

2021–22–A term

Course Name Homological Algebra

Course Number 201.2.2091

Course web page
`https://www.math.bgu.ac.il//~amyekut/teaching/2021-22/homol-alg/course_page.html`

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Office Hours `https://www.math.bgu.ac.il/en/teaching/hours`

Abstract

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.

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11. Morita Theory.

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

For an updated syllabus and course requirements see the course web page[1]

Requirements and grading[2]

see course web page[3]

[1] https://www.math.bgu.ac.il/~amyekut/teaching/2021-22/homol-alg/course_page.html

[2] Information may change during the first two weeks of the term. Please consult the webpage for updates

[3] 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

Prerequities:

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)

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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 subsequenct course "Commutative Algebra")

Course topics

Course Topics:

1. Categories and functors: natural transformations, equivalence, adjoint functors, additive functors, exactness.
2. Derived functors: projective, injective and flat modules; resolutions, the functors Ext and Tor; examples and applications.
3. Nonabelian cohomology and its applications.