אוניברסיטת
בן-גוריון בנגב

The Department of Mathematics

2019–20–B term

Course Name Homological Algebra

Course Number 201.2.2091

Course web page
`https://www.math.bgu.ac.il/~amyekut/teaching/2019-20/homol-alg/course_page.html`

Lecturer Prof. Amnon Yekutieli, <amyekut@bgu.ac.il>, Office 202

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

Abstract

Description: This is a graduate level course. Undergraduate students can register with my permission.

The prerequisite course is "Commutative Algebra" that I gave in the fall semester (or an equivalent course). We will need the following topics from that course: categories and functors; additive and exact functors; free modules; products and coproducts; tensor products of modules and rings.

The pace of the course, and the amount of material covered, will be determined by the background and capabilty of the audience. There will be many examples and exercises. I will upload typed notes after every lecture.

Course Grade: pass/fail grade. Passing the course requires attending all lectures and submitting most of the homework.

Homework: To be assigned every week. Checking will be sporadic.

See the first day handout for more administrative information.

Course Topics:

.1 Adjoint functors.

.2 Morita Theory.

.3 Projective and Injective modules.

.4 Complexes of modules.

.5 Homotopies and homotopy equivalences.

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.6 The long exact cohomology sequence.

.7 Projective, flat and injective resolutions.

.8 Left and right derived functors.

.9 Applications of derived functors to commutative algebra.

.10 Further applications of derived functors and cohomology.

Requirements and grading[1]

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

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

22 February 2020

Course Announcement:

Homological Algebra

Spring Semester 2019-20

Catalog Number: 201.2.2091
Time: Wednesday 12:00 – 14:00
Place: Building 58 room 201
First meeting: 11 March 2020
Teaching Language: English
Web Page: https://www.math.bgu.ac.il/~amyekut/teaching/2019-20/homol-alg/course_page.html

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7. Projective, flat and injective resolutions.
8. Left and right derived functors.
9. Applications of derived functors to commutative algebra.
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Bibliography:

1. P.J. Hilton and U. Stammbach, "A Course in Homological Algebra", Springer, 1971.
2. S. Maclane, "Homology", Springer, 1994.
3. J. Rotman, "An Introduction to Homological Algebra", Academic Press, 1979.
4. L.R. Rowen, "Ring Theory" (Student Edition), Academic Press, 1991.
5. C. Weibel, "An introduction to homological algebra", Cambridge Univ. Press, 1994.
6. A. Yekutieli, "Derived Categories", Cambridge Univ. Press, 2019.
7. Course notes, to be uploaded every week to the course web page.

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Course topics

.1 Recalling prior material. Rings (including noncommutative), ideals, modules and bimodules, exact sequences, infinite direct sums and products, tensor products of modules and rings.

.2 Categories and functors. Morphisms of functors, equivalences. Linear categories and linear functors. Exactness of functors.

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

.4 Morita Theory. Equivalences of module categories realized as tensor products.

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

.6 Resolutions. Projective, injective and flat resolutions – existence and uniqueness.

.7 Left and right derived functors. The general theory. Tor and Ext functors.

.8 Applications to commutative algebra. Some local and global theorems, involving Tor and Ext functors. Derived completion and torsion functors.

.9 Sheaf cohomology. A survey of the role of homological algebra in geometry.

.10 Nonabelian cohomology. A survey of classfiication theorems: Galois cohomology, vector bundles.

Bibliography

.1 R. Hartshorne, "Algebraic Geometry", Springer-Verlag, New-York, .1977

.2 P.J. Hilton and U. Stammbach, "A Course in Homological Algebra", Springer, .1971

.3 S. Maclane, "Homology", Springer, .1994

.4 J. Rotman, "An Introduction to Homological Algebra", Academic Press, .1979

.5 L.R. Rowen, "Ring Theory" (Student Edition), Academic Press, .1991

.6 C. Weibel, "An introduction to homological algebra", Cambridge Univ. Press, .1994

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

.8 The Stacks Project[2], an online reference, J.A. de Jong (Editor). (9) A. Yekutieli, "Derived Categories", Cambridge Univ. Press, .2019 Free prepublication version[3]. (10) Course notes, to be uploaded every week to the course web page

[2] http://stacks.math.columbia.edu
[3] https://arxiv.org/abs/1610.09640v4