BEN GURION UNIVERSITY **אוניברסיטת בן גוריון בנגב**

Prof. Amnon Yekutieli
Department of Mathematics
Ben Gurion University
Be'er Sheva 84105, ISRAEL
Web: www.math.bgu.ac.il/~amyekut
Email: amyekut@math.bgu.ac.il

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

10 October 2021

Course Announcement:

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"

Practical Information. The course will be in English.

It is planned to start in hybrid format (in-person lectures and on Zoom), but the format might change.

The first lecture will be on Wednesday 20 October 2021.

The course web page (with up-to-date information):

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

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

Participants of the course should have good knowledge of the prerequisite material, and hopefully at least some of the recommended material. The level of the course will be calibrated – in terms of rate of progress and sophistication of the presentation – to the audience.

Participants from outside the BGU community are welcome.

The course "Commutative Algebra" in the spring semester will be a continuation of this course, and participation in it will require attending the present course (or knowledge of the material).

Registration and Grading. There will be no exam, and the grade will be pass/fail. Participants are expected to attend all lectures (even if not registered). To pass the course, registered participants should attend all lectures, and submit most of the homework assignments.

Please **send me an email if you are considering attending the course**, in-person or by Zoom, indicating which of the topics above you have learned (in a formal course or privately), your academic status (degree, year and institution), whether you intend to register or just to listen, and whether you have a strong preference to participate by Zoom. I will create a mailing list. The Zoom link will be sent through this list.

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 and functors. (This topic will be itroduced 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")

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. Free prepublication version (on arxiv).
7. Course notes, to be uploaded every week to the course web page.