BEN GURION UNIVERSITY

אוניברסיטת בן גוריון בנגב

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

23 July 2019

Course Announcement:

Commutative Algebra

Fall Semester 2019-20

Catalog Number: 201.2.2011
Time: Wednesday 12:00 – 14:00
Place: Building 58 room 201
Teaching Language: English
Web Page: www.math.bgu.ac.il/~amyekut/teaching/2019-20/comm-alg/course_page.html

Description: This is a graduate level course. Undergraduate students can register with my permission. The prerequisite course is "Algebraic Structures". Other algebra courses, such as "Introduction to Commutative Algebra" or "Galois Theory", are highly recommended. 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.

This course is a **prerequisite for the course "Homological Algebra"** in the spring semester.

Course Topics:

1. **Review of prior material.** On rings, ideals and modules.
2. **Categories and functors.** Emphasis on linear categories, linear functors and morphism between linear functors. Exactness. (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. Flatness. Tensor products of rings, adjunction formulas, relations to Galois Theory. Symmetric and exterior tensor powers.
5. **Localization.** Localizing rings and modules. Flatness of localization. Local rings and Nakayama's Lemma.
6. **Prime spectrum.** Definition, Zariski topology, dimension, support of modules, connectedness and idempotents, local properties of modules.
7. **Noetherian rings.** Definition, basic properties, Hilbert Basis Theorem, Artin-Rees Lemma, completion, Cohen Structure Theorem.

8. **Dimension theory.** Noether Normalization, transcendence degree, dimension theorems, Hilbert Nullstellensatz.
9. **Regularity.** Regular sequences, grading, regular rings, normal rings, Cohen-Macaulay rings.
10. **Differential Algebra.** Derivations, differential forms, smooth and étale homomorphisms, relations to Galois Theory and differential geometry.

Bibliography:

1. Eisenbud, "Commutative Algebra"
2. Altman and Kleiman, "A Term of Commutative Algebra" (free online book)
3. Matsumura, "Commutative Ring Theory"
4. Course notes, to be uploaded every week to the course web page.