אוניברסיטת
בן-גוריון בנגב

The Department of Mathematics

2019–20–A term

Course Name Commutative Algebra

Course Number 201.2.2011

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

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

Abstract

Requirements and grading[1]

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.

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

אוניברסיטת
בן-גוריון בנגב

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.

Course topics

Course Topics

1. Modules: free modules, exact sequences, tensor products, Hom modules, flatness.
2. Prime ideals and localization: local rings, Nakayama's Lemma, the spectrum of a ring, dimension and connectedness.
3. Noetherian rings: the Hilbert basis theorem, the Artin-Rees lemma, completion, grading.
4. Dimension theory: the Hilbert nullstellensatz, Noether normalization, transcendence degree.