

# The Department of Mathematics

2024–25–A term

**Course Name** Noncommutative algebra

**Course Number** 201.2.5121

**Course web page**

<https://www.math.bgu.ac.il/en/teaching/fall2025/courses/noncommutative-algebra>

**Lecturer** Prof. Ido Efrat, <efrat@bgu.ac.il>, Office 106

**Office Hours** <https://www.math.bgu.ac.il/en/teaching/hours>

## Abstract

## Requirements and grading<sup>1</sup>

### Course topics

- .1 Basic Algebraic Structures: rings, modules, algebras, the center, idempotents, group rings
- .2 Division Rings: the Hamiltonian quaternions, generalized quaternion algebras, division algebras over  $\mathbb{F}_q$ ,  $\mathbb{C}$ ,  $\mathbb{R}$ ,  $\mathbb{Q}$  (theorems of Frobenius and Wedderburn), cyclic algebras, the Brauer–Cartan–Hua theorem
- .3 Simplicity and semi-simplicity: simplicity of algebraic structures, semi-simple modules, semi-simple rings, Maschke’s theorem
- .4 The Wedderburn–Artin Theory: homomorphisms and direct sums, Schur’s lemma, the Wedderburn–Artin structure theorem, Artinian rings
- .5 Introduction to Group Representations: representations and characters, applications of the Wedderburn–Artin theory, orthogonality relations, dimensions of irreducible representations, Burnside’s theorem
- .6 Tensor Products: tensor products of modules and algebras, scalar extensions, the Schur index, simplicity and center of tensor products, the Brauer group, the Skolem–Noether theorem, the double centralizer theorem, maximal fields in algebras, reduced norm and trace, crossed products

---

<sup>1</sup>Information may change during the first two weeks of the term. Please consult the webpage for updates