Study Guide for Final Exam – MATH 3010 Fall 2024

The final exam is cumulative and covers:

- Sets, Integers, and Congruence: Sections A.5–A.8, 1.1 – 1.4, 2.1 – 2.5,
- Rings: Sections 3.1–3.3, 4.1–4.4, 5.2, 5.3, 5.5,
- Polynomial Rings: Section 7.2–7.5,
- Groups: Sections 11.1–11.5, 12.1.

The following topics won't appear on the final exam:

- RSA encryption algorithm (appears in Section 2.5),
- Group actions (from Section 11.2),
- Conjugacy classes and Proposition 11.57 (from Section 11.4),
- Canonical decomposition for groups (Theorem 11.67 in Section 11.4),
- 2nd and 3rd Isomorphism Theorems (Prp. 11.73, Thms. 11.74 and 11.75).

A rough outline of the most important topics:

- The Well-Ordering Principle
- Zero-divisors and units in a commutative ring R
- Definition of integral domain and field
- Fermat's Little Theorem
- Definition of a ring homomorphism and ring isomorphism
- Subrings, kernels, ideals
- Quotient rings and First Isomorphism Theorem for Rings
- $F[x]$ is a principal ideal domain
- Fundamental Theorem of Algebra
- Rational Root Test
- Eisenstein's Criterion
- Groups and subgroups
- The dihedral group D_{2n}, as symmetries of regular polygons; generators r, s and their relations
- Symmetric group S_n, cycles and transpositions, even/odd permutations, the alternating group A_n
- Cyclic subgroups, order of an element in a group
- Left and right cosets of a subgroup H in a group G; Lagrange's Theorem
- Normal subgroups and quotient groups G/N
- The First Isomorphism Theorem for Groups