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Boolean-Algebraic Framework for Maximal-Degree U-k-Seminets: Theoretical Foundations and Computational Advances

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Abstract

A Boolean-algebraic framework for maximal-degree U-k-seminets is presented, unifying combinatorial and algebraic properties. This work ex tends Aczel's quasigroup theory and Belousov's k-net constructions by in traducing a computational framework for U-k-seminets of maximal degree μ. Key results include: (1) explicit bounds for μ in terms of set cardinality t and t-order d (μ = t−d+2), (2) existence conditions for no equipotent sets, and (3) inequalities governing μ and t ((t+2)/2 < μ ≤ t). Theorems are validated via tabulated solutions for m = t − d, demonstrating scal able applications in finite geometry and network design. The framework bridges partial quasigroups and block designs, offering algorithmic tools for seminets with maximal degree constraints.

Keywords: U-k-Seminets, Maximal Degree, T-Order, Boolean Algebra, Par Tial Quasigroups, Combinatorial Designs, Finite Geometry, Network Coding

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