Discrete Mathematics Using Latin Squares. *By Charles F. Laywine and Gary L. Mullen.* Wiley-Interscience, New York, 1998. ISBN 0-471-24064-8.

A common complaint about many introductory discrete mathematics textbooks is that there is little continuity or few pervasive themes, and the texts appear to be a hodgepodge of disjoint topics. Typically, early chapters cover the basic ideas of logic, sets, number theory and functions, and then proceed through a long list of topics from basic combinatorics, boolean algebra, graph theory, finite-state automata, formal languages and the like, with very little "glue" to make it all hang together and appear as a coherent subject. This complaint will *never* be leveled at the text under review.

The authors, who are active and accomplished researchers in combinatorics and algebra, have chosen to use the vehicle of Latin squares, and their generalizations, for exposing a student to topics in discrete mathematics. This is an excellent decision, as the student that carefully works through a substantial portion of this book will wrestle with all of the preliminary material in a typical textbook, and a sizeable fraction of the main topics. As an incomplete list, a student can learn about sets, number theory, counting formulas, inclusion-exclusion, graph theory, groups, rings (especially of polynomials), finite fields, finite geometries, combinatorial designs, design of experiments, error-correcting codes and cryptology (RSA, discrete logarithms). There is little coverage of topics that are oriented more toward computer science, like finite-state machines, formal languages or complexity.

Consistent with the overriding design of this text, the excellent initial chapter jumps right into the study of Latin squares, followed by a chapter on mutually orthogonal Latin squares. No Chapter Zero on sets, relations and functions here. The goal is to show the student some interesting and nontrivial results early and start to establish some connections between what may seem to the uninitiated as disparate topics. However, this second chapter requires the use of an irreducible polynomial over a finite field. Heady stuff for a book whose preface says "The mathematical background required to use this book is not extensive" and whose back cover shouts "An intuitive and accessible approach..."

Here lies the reviewer's one hesitation. To get a fast start, certain necessary topics have been dished out to appendices. The instructor who chooses this text must decide how great a detour is needed to cover this material, and if this negates the benefits of a fast start. For example, Appendix A.1 begins with modular arithmetic and the ring axioms and then constructs finite fields using irreducible polynomials, all in the space of five pages. For students with a typical year-long upper-division course in abstract algebra, such as one based on a text like Gallian [1], these appendices will serve the purpose of a quick refresher and ready reference. For a student without this background in algebra, the appendices could be overwhelming. The second author's publication list at his website [2] describes the text more accurately as an "upper division undergraduate/beginning graduate level text."

For the student with the necessary background in algebra, this book will allow for the study of many mainstream topics in discrete mathematics, while simultaneously allowing the student to see a unified theory of a specialized area of combinatorics and the interplay between a variety of ideas and constructions. The book also has many applications (such as error-correcting codes, cryptography, design of experiments, and (t, m, s)-nets in numerical analysis), so a course of study can be designed with a very applied flavor. Indeed, beyond the first two chapters it appears that many of the chapters are independent, so instructors can vary the balance between theoretical and applied to suit their needs or tastes. Fifteen of the sixteen chapters conclude with exercises, numbering somewhere from about five to twenty-five, with hints or solutions for almost all of them in the back of the book. Each chapter also has a page of notes, and twenty or so references, providing pointers for the reader that wants to pursue a topic further, perhaps even to the forefront of current research. The exercises, solutions and notes are sufficient enough that the motivated and prepared student could likely succeed using this text for independent study.

This textbook is a welcome addition and expands the options available for teaching discrete mathematics to an audience of mathematically mature students with the proper algebraic background. It is refreshing to see authors take a subject they are passionate about and design a unique text around that topic while simultaneously covering many of the basic topics expected in a text describing discrete mathematics (to say nothing of a publisher willing to support such a project).

References

[1] Gallian, Joseph A. Contemporary Abstract Algebra. Fifth Edition. Houghton Mifflin College, 2001.

[2] Mullen, Gary L. `http://www.math.psu.edu/mullen/`. February 20, 2002.

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