MATCH
Communications in Mathematical and in Computer Chemistry

MATCH Commun. Math. Comput. Chem. **54** (2005) 481-484

ISSN 0340 - 6253

A Review of

Russell Merris, Combinatorics, 2nd Edition, Wiley-Interscience, 2003

Combinatorics, by Russell Merris, is a worthy addition to any mathematical library. It is a 556 page, well organized textbook which is at once educational, informative, and entertaining.

The book covers a great deal of material in the field of Combinatorics, so much so that it would be easy to lose one's way were it not for the fact that the material is so well organized. A road map in the preface shows several different paths of study through the book, allowing the reader with a particular goal in mind to efficiently move through the necessary fundamental information without wasting time wading through unnecessary material. On the other hand, a reader looking for a general understanding of Combinatorics will find this book packed with a wide variety of material presented in an orderly way, and should be able to work his way through the book from start to finish, ending up with an understanding lacking in neither breadth nor depth.

The areas of Combinatorics covered in this book include the following:

The Fundamental Counting Principle
Pascal's Triangle
Elementary Probability
Error-Correcting Codes
The Binomial and Multinomial Theorems
Partitions
Elementary Symmetric Functions
Combinatorial Algorithms

Stirling Numbers of the First and Second Kind
Bell numbers
The Principle of Inclusion and Exclusion

Disjoint Cycles

Permutation Groups
Burnside's Lemma
Symmetry Groups
Color Patterns
Polya's Theorem of Enumeration
The Cycle Index Polynomial

Ordinary Generating Functions
Applications of Generating Functions
Exponential Generating Functions

The Pigeonhole Principle
Edge Colorings and Ramsey Theory
Chromatic Polynomials
Planar Graphs
Matching Polynomials
Oriented Graphs
Graphic Partitions

Linear Codes
Decoding Algorithms
Latin Squares
Balanced Incomplete Block Designs

This is not a complete list; suffice it to say that Merris' book covers a breadth of material comparable to texts by Brualdi, Bogart, and vanLint & Wilson.

From the standpoint of utility, the material itself is presented well. Definitions, theorems, and examples are clearly labeled and easy to find. Conventions used are identified and labeled, which is a nice touch not found in many textbooks. There is an index of notation that is particularly helpful, making unnecessary the otherwise inevitable digging through previous chapters in search of the first use of some obscure symbol or other. The general index could be more complete, but is still fairly well populated.

Difficult concepts are presented with clarity and precision of logic. The author has a flowing, engaging writing style which is conversational and informative. This book is not dry like many textbooks. Dr. Merris seems less concerned with showing the reader how smart he is, as many authors of mathematical texts seem to be, and more concerned with the reader gaining an understanding of the material. He makes liberal use of asides and analogies, as well as providing many down-to-earth examples. At times the analogies are so obscure as to be distracting (for instance, the reference to riparian habitat at the end of section 3.1 seems enough of a stretch so as to detract from the discussion on

the underpinnings of Polya's Theorem), but for the most part they serve to capture the interest of the reader and to facilitate a deeper understanding of the material. A good teacher is one who can make the complex seem simple, and that is what he has done for the most part. His distinctive, witty style results in a text that is perhaps not as efficient as competing books, but it certainly makes for enjoyable reading and a more thorough understanding of the material.

There are an abundance of exercises supporting each section in the book, ranging from relatively easy to relatively difficult. Some of the exercises provide gentle reinforcement of the fundamental concepts in the associated section, while others are far more challenging, facilitating much deeper exploration and understanding of various aspects of the material at hand.

One nice difference between this text and those of Bogart and Brualdi is the exposition of Polya's Theorem. A full 75 pages are devoted to this topic, compared to 39 pages in Bogart and 40 pages in Brualdi. The chapter on Polya's Theorem begins with a discussion on function composition, in particular composition of permutations, moving from there to a nice explanation of permutation groups. Burnside's Lemma is presented next, and in such a way that it can be applied to more than just the development of Polya's Theorem. From there the discussion moves to symmetry groups, then color patterns are introduced and explained, and finally Polya's Theorem itself is presented. The chapter ends with a discussion of the cycle index polynomial. This treatment of Polya's Theorem is far from cursory and is not lacking in depth. The material does not feel rushed or abbreviated, as in Brualdi.

This book should be approachable by anyone with decent mathematical ability, yet contain enough depth of information for serious students in the field of Combinatorics. This reviewer highly recommends Combinatorics, 2nd Edition, by Russell Merris.

Glenn Orr