Abstract Algebra: An Introduction, 3rd

Chapter 1

Arithmetic in Z Revisited

1.1 The Division Algorithm

1. (a) $q = 4$, $r = 1$. (b) $q = 0$, $r = 0$. (c) $q = -5$, $r = 3$.

2. (a) $q = -9$, $r = 3$. (b) $q = 15$, $r = 17$. (c) $q = 117$, $r = 11$.

3. (a) $q = 6$, $r = 19$. (b) $q = -9$, $r = 54$. (c) $q = 62720$, $r = 92$.

4. (a) $q = 15021$, $r = 132$. (b) $q = -14940$, $r = 335$. (c) $q = 39763$, $r = 3997$.

5. Suppose $a = bq + r$, with $0 \le r < b$. Multiplying this equation through by c gives $ac = (bc)q + rc$. Further, since $0 \le r < b$, it follows that $0 \le rc < bc$. Thus this equation expresses ac as a multiple of bc plus a remainder between 0 and $bc - 1$. Since by Theorem 1.1 this representation is unique, it must be that q is the quotient and rc the remainder on dividing ac by bc.

6. When q is divided by c, the quotient is k, so that $q = ck$. Thus $a = bq + r = b(ck) + r = (bc)k + r$. Further, since $0 \le r < b$, it follows (since $c \ge 1$) that $0 \le r < bc$. Thus $a = (bc)k + r$ is the unique representation with $0 \le r < bc$, so that the quotient is indeed k.

7. Answered in the text.

8. Any integer n can be divided by 4 with remainder r equal to 0, 1, 2 or 3. Then either $n = 4k$, $4k + 1$, $4k + 2$ or $4k + 3$, where k is the quotient. If $n = 4k$ or $4k + 2$ then n is even. Therefore if n is odd then $n = 4k + 1$ or $4k + 3$.

9. We know that every integer a is of the form $3q$, $3q + 1$ or $3q + 2$ for some q. In the last case $a^2 = (3q + 2)^2 = 27q^2 + 54q^2 + 36q + 8 = 9k + 8$ where $k = 3q^3 + 6q^2 + 4q$. Other cases are similar.

10. Suppose $a = nq + r$ where $0 \le r < n$ and $c = nq' + r'$ where $0 < r' < n$. If $r = r'$ then $a - c = n(q - q')$ and $k = q - q'$ is an integer. Conversely, given $a - c = nk$ we can substitute to find: $(r - r') = n(k - q + q')$. Suppose $r \ge r'$ (the other case is similar). The given inequalities imply that $0 \le [r - r'] \le r$. It follows then that $0 \le (r - r') < 1$ and we conclude that $k - q + q' = 0$. Therefore $r = r'$, so that $r = r'$ as claimed.

Hungerford Abstract Algebra Solutions

Mark A. Lau,Stephen J. Sugden

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Abstract Algebra Manual Ayman Badawi,2004 This is the most current textbook in teaching the basic concepts of abstract algebra The author finds that there are many students who just memorise a theorem without having the ability to apply it to a given problem Therefore this is a hands on manual where many typical algebraic problems are provided for students to be able to apply the theorems and to actually practice the methods they have learned Each chapter begins with a statement of a major result in Group and Ring Theory followed by problems and solutions Contents Tools and Major Results of Groups Problems in Group Theory Tools and Major Results of Ring Theory Problems in Ring Theory Index Abstract Algebra Thomas W. Hungerford,1997 Discrete Mathematics Using Latin Squares Charles F. Laywine,Gary L. Mullen,1998-09-17 Over the past two decades research in the theory of Latin Squares has been growing at a fast pace and new significant developments have taken place This book offers a unique approach to various areas of discrete mathematics through the use of Latin Squares Innovations in Teaching Abstract Algebra Allen C. Hibbard,Ellen J. Maycock,2002 **Applications of Spreadsheets in Education** Mark A. Lau,Stephen J. Sugden,2011-09-20 This e book is devoted to the use of spreadsheets in the service of education in a broad spectrum of disciplines science mathematics engineering business and general education The effort is aimed at collecting the works of prominent researchers and **CRC Concise Encyclopedia of Mathematics** Eric W. Weisstein,2002-12-12 Upon publication the first edition of the CRC Concise Encyclopedia of Mathematics received overwhelming accolades for its unparalleled scope readability and utility It soon took its place among the top selling books in the history of Chapman Hall CRC and its popularity continues unabated Yet also unabated has been the d **The Bulletin of Mathematics Books** ,1992 A Journey Through The Realm of Numbers Menny Aka,Manfred Einsiedler,Thomas Ward,2020-10-03 This book takes the reader on a journey from familiar high school mathematics to undergraduate algebra and number theory The journey starts with the basic idea that new number systems arise from solving different equations leading to abstract algebra Along this journey the reader will be exposed to important ideas of mathematics and will learn a little about how mathematics is really done Starting at an elementary level the book gradually eases the reader into the complexities of higher mathematics in particular the formal structure of mathematical writing definitions theorems and proofs is introduced in simple terms The book covers a range of topics from the very foundations numbers set theory to basic abstract algebra groups rings fields driven throughout by the need to understand concrete equations and problems such as determining which numbers are sums of squares Some topics usually reserved for a more advanced audience such as Eisenstein integers or quadratic reciprocity are lucidly presented in an accessible way The book also introduces the reader to open source software for computations to enhance understanding of the material and nurture basic programming skills For the more adventurous a number of Outlooks included in the text offer a glimpse of possible mathematical excursions This book supports readers in transition from high school to university mathematics and

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