

Abstract Algebra: An Introduction, 3rd

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Chapter 1

Arithmetic in $\mathbb{Z}$ Revisited

1.1 The Division Algorithm

- $q = 4, r = 1.$
 - $q = 0, r = 0.$
 - $q = -5, r = 3.$
- $q = -9, r = 3.$
 - $q = 15, r = 17.$
 - $q = 117, r = 11.$
- $q = 6, r = 19.$
 - $q = -9, r = 54.$
 - $q = 62720, r = 92.$
- $q = 15021, r = 132.$
 - $q = -14940, r = 335.$
 - $q = 39763, r = 3997.$
- Suppose $a = bq + r$, with $0 \leq r < b$. Multiplying this equation through by c gives $ac = (bc)q + rc$. Further, since $0 \leq r < b$, it follows that $0 \leq rc < bc$. 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 .
- 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 $0 \leq r < b$, it follows (since $c \geq 1$) that $0 \leq r < bc$. Thus $a = (bc)k + r$ is the unique representation with $0 \leq r < bc$, so that the quotient is indeed k .
- Answered in the text.
- 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 $4k + 3$.
- We know that every integer a is of the form $3q$, $3q + 1$ or $3q + 2$ for some q . In the last case $a^2 = (3q + 2)^2 = 9q^2 + 12q + 4 = 3(3q^2 + 4q + 1) + 1$. Other cases are similar.
- Suppose $a = bq + r$ where $0 \leq r < a$ and $c = bq' + r'$ where $0 \leq r' < a$. If $r = r'$ then $a - c = b(q - q')$ and $k = q - q'$ is an integer. Conversely, given $a - c = ak$ we can substitute to find: $(r - r') = a(k - q + q')$. Suppose $r \geq r'$ (the other case is similar). The given inequalities imply that $0 \leq (r - r') < a$ and it follows that $a \mid (r - r') < a$ and we conclude that $k - q + q' = 0$. Therefore $r = r'$, $q = q'$ and $a \mid (a - c)$.
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leisurely and fairly comprehensive introduction to Gr bner bases and their applications Adams and Loustau cover the following topics the theory and construction of Gr bner bases for polynomials with coefficients in a field applications of Gr bner bases to computational problems involving rings of polynomials in many variables a method for computing syzygy modules and Gr bner bases in modules and the theory of Gr bner bases for polynomials with coefficients in rings With over 120 worked out examples and 200 exercises this book is aimed at advanced undergraduate and graduate students It would be suitable as a supplement to a course in commutative algebra or as a textbook for a course in computer algebra or computational commutative algebra This book would also be appropriate for students of computer science and engineering who have some acquaintance with modern algebra **Abstract Algebra** Thomas (Cleveland State University)

Hungerford,2020-10 **Abstract Algebra** An Introduction is set apart by its thematic development and organization The chapters are organized around two themes arithmetic and congruence Each theme is developed first for the integers then for polynomials and finally for rings and groups This enables students to see where many abstract concepts come from why they are important and how they relate to one another New to this edition is a groups first option that enables those who prefer to cover groups before rings to do so easily **Abstract Algebra** Thomas W. Hungerford,1997 [The Basics of Abstract Algebra](#) Bland,2002-08 [Subject Guide to Books in Print](#) ,1997 **A Concrete Approach To Abstract Algebra,Student Solutions Manual (e-only)** Jeffrey Bergen,2010-04-15 A Concrete Approach to Abstract Algebra begins with a concrete and thorough examination of familiar objects like integers rational numbers real numbers complex numbers complex conjugation and polynomials in this unique approach the author builds upon these familiar objects and then uses them to introduce and motivate advanced concepts in algebra in a manner that is easier to understand for most students The text will be of particular interest to teachers and future teachers as it links abstract algebra to many topics wich arise in courses in algebra geometry trigonometry precalculus and calculus The final four chapters present the more theoretical material needed for graduate study **Innovations in Teaching Abstract Algebra** Allen C. Hibbard, Ellen J. Maycock,2002

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