Research Article

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On 2r-ideals in commutative rings with zero-divisors

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Abstract: In this article, we are interested in uniformly pr-ideals with order ≤ 2 (which we call 2r-ideals) introduced by Rabia Üregen in [*On uniformly pr-ideals in commutative rings*, Turkish J. Math. **43** (2019), no. 4, 187818886]. Several characterizations and properties of these ideals are given. Moreover, the comparison between the (nonzero) 2r-ideals and certain classes of classical ideals gives rise to characterizations of certain rings based only on the properties of the ideals consisting only of zero-divisors. Namely, among other things, we compare the class of (nonzero) 2r-ideals with the class of (minimal) prime ideals, the class of minimal prime ideals and their squares, and the class of primary ideals. The study of 2r-ideal in polynomial rings allows us to give a new characterization of the rings satisfying the famous A-property.

Keywords: uniformly pr-ideals, zero-divisors, A-property

MSC 2020: 13A15, 13E05, 13F20

1 Introduction

Throughout, all rings considered are *commutative* with nonzero unity. Let R be a ring, I be an ideal of R, and S be a subset of R. Set $S^* = S\backslash\{0\}$ and $(I : S) = \{x \in R | xS \subset I\}$. The set of zero-divisors of R and the set of regular elements of R are denoted by $Z(R)$ and $\mathrm{Reg}(R)$, respectively. The ideal I is said to be proper if $I \neq R$. The radical of I is denoted by $\sqrt{I} = \{x \in R | x^n \in I \text{ for some integer } n \geq 1\}$ and the nil-radical of R is denoted by $\mathrm{nil}(R) = \sqrt{(0)}$. The total ring of fractions of R is denoted $Q(R) = \left\{\frac{a}{b} | a \in R \text{ and } b \in \mathrm{Reg}(R)\right\}$. The ring R is said to be a total quotient ring if $R = Q(R)$, or equivalently, every element in R is either a zero-divisor or a unit.

It is known that there are so many important rings with zero divisors that have interesting properties whose counterparts for the integral domains become trivial. Recently, there has been a lot of attention to the ideal theory of these rings (see [1–4]). For a ring R, the properties of $Q(R)$ provided by its ideals come from the ideals of R consisting entirely of zero divisors. An example of such ideals are the z^0-ideals (studied under the name d-ideals in [4]).

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Commutative Rings With Zero Divisors

John J. Watkins

Commutative Rings With Zero Divisors:

Commutative Rings with Zero Divisors James Huckaba,1988-03-21 The first book length discussion to provide a unified treatment of commutative ring theory for rings containing zero divisors by the ideal theoretic method Commutative Rings with Zero Divisors also examines other important questions regarding the ideals of rings with zero divisors that do not have counterparts for integral domains for example determining when the space of minimal prime ideals of a commutative ring is compact Unique features of this indispensable reference text include characterizations of the compactness of Min Spec development of the theory of Krull rings with zero divisors complete review for rings with zero divisors of problems on the integral closure of Noetherian rings polynomial rings and the ring R X theory of overrings of polynomial rings positive results on chained rings as homomorphic images of valuation domains plus much more In addition Commutative Rings with Zero Divisors develops properties of two important constructions for rings with zero divisors idealization and the A B construction It contains a large section of examples and counterexamples as well as an index of main results

Factorization in Commutative Rings with Zero Divisors and Related Topics Silvia R. Valdes-Leon,1993

U-factorizations in Commutative Rings with Zero Divisors Michael Christopher Axtell,2000 **Factorization in Polynomial Rings with Zero Divisors** Ranthony A.C. Edmonds,2018 Factorization theory is concerned with the decomposition of mathematical objects Such an object could be a polynomial a number in the set of integers or more generally an element in a ring A classic example of a ring is the set of integers If we take any two integers for example 2 and 3 we know that 2 cdot 3 3 cdot 2 which shows that multiplication is commutative Thus the integers are a commutative ring Also if we take any two integers call them a and b and their product a cdot b 0 we know that a or b must be 0 Any ring that possesses this property is called an integral domain If there exist two nonzero elements however whose product is zero we call such elements zero divisors This thesis focuses on factorization in commutative rings with zero divisors In this work we extend the theory of factorization in commutative rings to polynomial rings with zero divisors For a commutative ring R with identity and its polynomial extension R X the following questions are considered if one of these rings has a certain factorization property does the other If not what conditions must be in place for the answer to be yes If there are no suitable conditions are there counterexamples that demonstrate a polynomial ring can possess one factorization property and not another Examples are given with respect to the properties of atomicity and ACCP The central result is a comprehensive characterization of when R X is a unique factorization ring Various Topics on Graphical Structures Placed on Commutative Rings Darrin Weber,2017 In this dissertation we look at two types of graphs that can be placed on a commutative ring the zero divisor graph and the ideal based zero divisor graph A zero divisor graph is a graph whose vertices are the nonzero zero divisors of a ring and two vertices are connected by an edge if and only if their product is 0 We classify up to isomorphism all commutative rings without identity that have a zero divisor graph on 14 or fewer vertices An

ideal based zero divisor graph is a generalization of the zero divisor graph where for a ring R and ideal I the vertices are x epsilon R I vertical bar there exists y epsilon R I such that xy epsilon I and two vertices are connected by an edge if and only if their product is in I We consider cut sets in the ideal based zero divisor graph A cut set is a set of vertices that when they and their incident edges are removed from the graph separate the graph into several connected components We will describe all cut sets in the ideal based zero divisor graph for commutative rings with identity We also give some additional results about two other graphical structures as well as include a classification of realizable zero divisor graphs that have a specified girth and diameter for commutative rings with and without identity Groups, Rings And Modules With Applications M.R. Adhikari,A. Adhikari,2003 **Zero-divisor Conditions in Commutative Group Rings** Ryan Peter Schwarz,2011

Zero-divisor Graphs, Commutative Rings of Quotients, and Boolean Algebras ,2008 The zero divisor graph of a commutative ring is the graph whose vertices are the nonzero zero divisors of the ring such that distinct vertices are adjacent if and only if their product is zero We use this construction to study the interplay between ring theoretic and graph theoretic properties Of particular interest are Boolean rings and commutative rings of quotients **Groups, Modules, and Model Theory - Surveys and Recent Developments** Manfred Droste,László Fuchs,Brendan Goldsmith,Lutz Strüngmann,2017-06-02 This volume focuses on group theory and model theory with a particular emphasis on the interplay of the two areas The survey papers provide an overview of the developments across group module and model theory while the research papers present the most recent study in those same areas With introductory sections that make the topics easily accessible to students the papers in this volume will appeal to beginning graduate students and experienced researchers alike As a whole this book offers a cross section view of the areas in group module and model theory covering topics such as DP minimal groups Abelian groups countable 1 transitive trees and module approximations The papers in this book are the proceedings of the conference New Pathways between Group Theory and Model Theory which took place February 1 4 2016 in M lheim an der Ruhr Germany in honor of the editors colleague R diger G bel This publication is dedicated to Professor G bel who passed away in 2014 He was one of the leading experts in Abelian group theory **Generalized Factorization in Commutative Rings with Zero-divisors** Christopher Park Mooney,2013 There are several benefits to the regular factorization factorization approach due to the various notions of associate and irreducible coinciding on regular elements greatly simplifying many of the finite factorization property relationships Complete factorization is a very natural and effective approach taken to studying factorization in rings with zero divisors There are several nice results stemming from extending tau factorization in this way Lastly an appendix is provided in which several examples of rings satisfying the various finite factorization properties studied throughout the thesis are given **Commutative Rings** Ayman Badawi,2002 This volume presents up to date references on the latest developments in commutative algebra and related areas featuring 19 original articles on fundamental topics of current interest It covers arithmetical rings pullback construction elasticity and

factorisation A XB X domains distinguished domains going down domains semistar operations star operations trace properties pseudo valuation rings modules zerodivisor graphs normal maximal ideals and numerical semi groups This is a vital resource for research mathematicians algebraists commutative ring theorists and graduate students in these disciplines

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Structure in Zero-divisor Graphs of Commutative Rings Philip Stephen Livingston,1997 **Topics in Commutative Ring Theory** John J. Watkins,2009-02-09 Topics in Commutative Ring Theory is a textbook for advanced undergraduate students as well as graduate students and mathematicians seeking an accessible introduction to this fascinating area of abstract algebra Commutative ring theory arose more than a century ago to address questions in geometry and number theory A commutative ring is a set such as the integers complex numbers or polynomials with real coefficients with two operations addition and multiplication Starting from this simple definition John Watkins guides readers from basic concepts to Noetherian rings one of the most important classes of commutative rings and beyond to the frontiers of current research in the field Each chapter includes problems that encourage active reading routine exercises as well as problems that build technical skills and reinforce new concepts The final chapter is devoted to new computational techniques now available through computers Careful to avoid intimidating theorems and proofs whenever possible Watkins emphasizes the historical roots of the subject like the role of commutative rings in Fermat s last theorem He leads readers into unexpected territory with discussions on rings of continuous functions and the set theoretic foundations of mathematics Written by an award winning teacher this is the first introductory textbook to require no prior knowledge of ring theory to get started Refreshingly informal without ever sacrificing mathematical rigor Topics in Commutative Ring Theory is an ideal resource for anyone seeking entry into this stimulating field of study *Graphs from Rings* David F. Anderson,T. Asir,Ayman Badawi,T.

Tamizh Chelvam,2021-10-31 This book gives an overview of research on graphs associated with commutative rings The study of the connections between algebraic structures and certain graphs especially finite groups and their Cayley graphs is a classical subject which has attracted a lot of interest More recently attention has focused on graphs constructed from commutative rings a field of study which has generated an extensive amount of research over the last three decades The aim of this text is to consolidate this large body of work into a single volume with the intention of encouraging interdisciplinary research between algebraists and graph theorists using the tools of one subject to solve the problems of the other The topics covered include the graphical and topological properties of zero divisor graphs total graphs and their transformations and other graphs associated with rings The book will be of interest to researchers in commutative algebra and graph theory and anyone interested in learning about the connections between these two subjects *Commutative Rings* Irving Kaplansky,1966 *Abstract Algebra* William Paulsen,2009-07-29 By integrating the use of GAP and Mathematica Abstract Algebra An Interactive Approach presents a hands on approach to learning about groups rings and fields Each chapter includes both GAP and Mathematica commands corresponding Mathematica notebooks traditional exercises and several interactive computer problems that utilize GAP and Mathema **Schaum's Outline of Theory and Problems of Modern Algebra** Frank Ayres,1965 **TECHNICAL REPORT NO. 1 ZERO DIVISORS AND COMUTATIVITY OF RINGS** J.E. MCLAUGHLIN,1952 **Zero Divisors in Commutative Semigroup Rings** Billy Don Janeway,1981

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