AIMS AND SCOPE

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The Square Element Graph over a Ring

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Abstract. In this paper, we generalize the square element graph $\mathbb{S}q(R)$ by defining it over any ring R with unity. For a ring R with 1, $\mathbb{S}q(R)$ is defined as follows: it is a simple undirected graph where the vertex set is $R - \{0\}$, and two vertices are adjacent if and only if $a \neq b$ and $a + b = x^2$ for some $x \in R - \{0\}$. Using the results of $\mathbb{S}q(R)$ found earlier for finite commutative rings, here we first obtain some results regarding direct products of rings. Then we study $\mathbb{S}q(R)$ for infinite rings R. In particular, we obtain some results regarding connectedness, cycles and other properties of $\mathbb{S}q(\mathbb{Z})$. We also look at $\mathbb{S}q(\mathbb{Z}[x]), \mathbb{S}q(\mathbb{Z}_2[x])$, and $\mathbb{S}q(F)$, where F is any infinite field.

Keywords: Square element; Direct product; Finite field; Infinite graph; Complete graph.

1. Introduction

Graphs have been associated with algebraic structures in several ways (e.g.- in [1, 2, 4, 5]). In particular, interesting graph-theoretical structures of the set of zero-divisors of a ring have been revealed by studying the zero-divisor graph. This motivated us to define another interesting graph over a ring R using the set $S = \{x^2 \mid x \in R - \{0\}\}$. Like the set of zero-divisors, the set S is not closed under addition in general. Also, this is multiplicatively closed for a commutative