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Commutativity of Some Graph Operators

Jeepamol J. Palathingal[1,*], *Aparna Lakshmanan S.*[2]
[1]Department of Mathematics, P.M. Government College, Chalakudy, Kerala, India
[2]Department of Mathematics, St. Xavier's College for Women, Aluva, Kerala, India

Abstract

The line graph L(G) of a graph G has the edges of G as its vertices and two distinct edges of G are adjacent in L(G) if they are incident in G. In this paper we consider the commutativity of the line graph operator with some other operators such as Gallai graph Γ(G), anti- Gallai graph Δ(G), kth *power of a graph* $Pow_k(G)$*, k-distance graph* $T_k(G)$*, cycle graph* $C_y(G)$*, block graph B(G), subdivision graph S(G), total graph T(G) and middle graph Mid(G).*

Keywords: *Line graph, graph operators, commutativity*

****Author for Correspondence*** E-mail: jeepamoljp@gmail.com

INTRODUCTION

A graph operator is a mapping Φ: Γ→ Γ, where Γ is the collection of all graphs or any subset of it. That is operations on graphs are a method by which we seek to construct new graphs from a set of graphs. There are so many operators out of which the first main operator is the line graph operator. Here we consider the commutativity of the line graph operator with some other operators—the Gallai graph Γ(G), the anti-Gallai graph Δ(G), k^{th} power of a graph $Pow_k(G)$, k-distance graph $T_k(G)$, cycle graph $C_y(G)$, block graph B(G), subdivision graph S(G), total graph T(G) and the middle graph Mid(G).

The line graph [1] L(G) of a graph G has the edges of G as its vertices and two distinct edges of G are adjacent in L(G) if they are incident in G. The Gallai graph Γ(G) and the anti-Gallai graph Δ(G) of a graph G has the same vertex set as that of L(G). In Γ(G), two distinct edges of G are adjacent if they are incident in G, but do not span a triangle in G [2]. But in Δ(G), two distinct edges of G are adjacent, if they are incident in G and lie on a triangle in G [2]. Both the Gallai and the anti-Gallai graphs are spanning subgraphs of the line graph and Γ(G) is the complement of Δ(G) in L(G). Though L(G) has a forbidden subgraph characterization, both the Gallai graphs and the anti-Gallai graphs do not have the vertex hereditary property and hence cannot be characterized by using forbidden subgraphs [2]. In [2], it has been proved that Γ(G) is isomorphic to G only for cycles of length greater than 3. In [3], we have proved that, Γ(Δ(G))≅Δ(Γ(G))≅H, where H is diamond-free.

For every integer k>1, the k^{th} power of a graph G, $Pow_k(G)$ has the same vertex set as that of G and two distinct edges are adjacent whenever their distance in G is at most k. $Pow_2(G)$ is also called the square of G and is denoted by G^2. If d is the diameter of G then $Pow_k(G) = K_n$ for every $k \geq d$. Therefore, the sequence $Pow_k(G)$ is always convergent. Recognizing squares is N P-complete but there is polynomial time recognition of squares of trees, subdivisions of a graph and planar graphs [4, 5]. It is proved that, for a connected non-complete graph, $\delta(Pow_k(G)) > \delta(G)$, where δ(G) denotes the minimum degree of G [1].

For integer $k > 1$, the k-distance graph $T_k(G)$ of a graph G has the same vertex set as that of G and two vertices are adjacent in $T_k(G)$ whenever their distance in G is exactly k [6]. It is proved that, if n and k are relatively prime and $n \geq 2k + 1$, then C_n is T_k- fixed and every self-complementary graph with diameter 2 is T_2-fixed [6].

The cycle graph $C_y(G)$ of a graph G has all induced cycles of G as vertices and two

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The line graph $L(G)$ of a graph G has the edges of G as its vertices and two distinct edges of G are adjacent in $L(G)$ if they are incident in G. In this paper we consider the commutativity of the line graph operator with some other operators such as Gallai graph $\Gamma(G)$, anti- Gallai graph $\Delta(G)$, k^{th} power of a graph $Pow_k(G)$, k-distance graph $T_k(G)$, cycle graph $C_\gamma(G)$, block graph $B(G)$, subdivision graph $S(G)$, total graph $T(G)$ and middle graph $Mid(G)$.

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