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New Version of Degree-Based Topological Indices of Some Class of Graph

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ABSTRACT: Recently, Shigehalli and Kanabur have introduced new degree-based topological indices namely, AG_1 index, *SK* index and SK_2 index. In this paper, formula for computing similar family of graph is given.

Keywords: Degree-based Topological Indices, Path Graph, Cycle Graph.

1. Introduction:

Let *G* be a simple connected graph in chemical graph theory. In mathematical chemistry, a molecular graph is a simple graph such that its vertices correspond to the atoms and the edges to the bonds. And also a connected graph is a graph such that there is a path between all pairs of vertices. Note that hydrogen atoms are often omitted [1, 5].

All molecular graphs considered in this paper are finite, connected, loopless, and without multiple edges. Let $G = (V, E)$ be a graph with n vertices and m edges. The degree of a vertex $u \in V(G)$ is denoted by du and is the number of vertices that are adjacent to *u*. The edge connecting the vertices *u* and *v* is denoted by *uv*[1].

A walk of a graph *G* is an alternating sequence of vertices and edges beginning and ending with vertices, in which each edge is incident with the two vertices immediately preceding and following it. It is closed if end vertices are same and is open, otherwise. A walk is a trail if all the edges are distinct and it is a path if all the vertices (necessarily all the edges) are distinct. A closed walk is called the cycle, provided all its *n* vertices are distinct and $n \geq 3$ [1].

2. Computing the Topological Indices of Some Class of Graph.

The present work is motivated by previous research on some class of graph. Here we computed their corresponding topological index value of some class of graph [6, 7, 8, 9, and 10].

Definition 2.1: Arithmetic-Geometric (AG_1) index

Let G = (V, E) be a molecular graph, and du is the degree of the vertex u, then AG_1 index of G is defined as

$$AG_1(G) = \sum_{u,v \in E(G)} \frac{du + dv}{2\sqrt{du.dv}}$$

Where, AG_1 index is considered for distinct vertices.

The above equation is the sum of the ratio of the Arithmetic mean and Geometric mean of u and v, where du (or dv) denotes the degree of the vertex u (or v).

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Definition 2.2: SK index

The SK index of a graph G = (V, E) is defined as SK (G) = $\sum_{u,v\in E(G)} \frac{du+dv}{2}$, where du and dv are the degrees of the vertices u and v in G.

Definition 2.3: SK_1 index

The SK_1 index of a graph G = (V, E) is defined as SK_1 (G) = $\sum_{u,v\in E(G)} \frac{dudv}{2}$, where du and dv are the product of the degrees of the vertices u and v in G.

3. Main Results:

Theorem 3.1: The AG_1 index of path graph of order 'n' is given by

$$AG_1(G) = \begin{cases} \sum_{n=1}^{m}(2n+h), \text{ for odd path} \\ \sum_{n=1}^{m}(2n-1)+h, \text{ for even path} \end{cases}$$

Proof:

The AG_1 index is

$$AG_1(G) = \sum_{u,v\in E(G)} \frac{du+dv}{2\sqrt{du.dv}}$$

Case-1: For odd Path

If P_n denotes an odd path of order n then

$$AG_1(P_3) = \frac{3}{\sqrt{2}},\ AG_1(P_5) = \frac{3}{\sqrt{2}}+2,\ AG_1(P_7) = \frac{3}{\sqrt{2}}+4 \ldots AG_1(P_m) = \frac{3}{\sqrt{2}}+m$$

Adding all the above equations:

$$AG_1(P_3)+AG_1(P_5)+\ldots+AG_1(P_m) = \frac{3}{\sqrt{2}}+\frac{3}{\sqrt{2}}+2+\frac{3}{\sqrt{2}}+4+\ldots\ldots+\frac{3}{\sqrt{2}}+m$$

$$\sum_{n=1}^{m} AG(P_n) = \left(\frac{3}{\sqrt{2}}+0\right)+\left(\frac{3}{\sqrt{2}}+2\right)+\left(\frac{3}{\sqrt{2}}+4\right)\ldots\ldots\ldots\ldots\ldots\ldots+\left(\frac{3}{\sqrt{2}}+m\right)$$

$$=[2+4+\ldots+m]+\left[\underbrace{\frac{3}{\sqrt{2}}+\frac{3}{\sqrt{2}}+\frac{3}{\sqrt{2}}+\ldots+\frac{3}{\sqrt{2}}}_{h-\text{times}}\right]$$

$$=\sum_{n=1}^{m} 2n + \sum \frac{3}{\sqrt{2}}$$

$$=\sum_{n=1}^{m} 2n + h.$$

Where, n=1, 2, 3… m

Case-2: For even path

If P_n denotes an even path of order n then

$$AG_1(P_4) = \frac{3}{\sqrt{2}} + 1,\ AG_1(P_6) = \frac{3}{\sqrt{2}} + 3 \ldots AG_1(P_m) = \frac{3}{\sqrt{2}} + m$$

Adding all the above equations:

$$AG_1(P_4) + AG_1(P_6) + \ldots\ldots + AG_1(P_m) = \frac{3}{\sqrt{2}} + 1 + \frac{3}{\sqrt{2}} + 3 + \ldots\ldots + \frac{3}{\sqrt{2}} + m$$

$$\sum_{n=2}^{m} AG_1(P_n) = \left(\frac{3}{\sqrt{2}} + 1\right) + \left(\frac{3}{\sqrt{2}} + 3\right) + \ldots\ldots + \left(\frac{3}{\sqrt{2}} + m\right)$$

$$= [1 + 3 + \ldots + m] + \left[\underbrace{\frac{3}{\sqrt{2}} + \frac{3}{\sqrt{2}} + \frac{3}{\sqrt{2}} + \ldots + \frac{3}{\sqrt{2}}}_{h-\text{times}}\right]$$

$$= \sum_{n=1}^{m} (2n-1) + \sum \frac{3}{\sqrt{2}}$$

$$= \sum_{n=1}^{m} (2n-1) + h.$$

Where, n=1, 2, 3… m

Corollary 3.1.1: The SK index of path graph ($P \geq 2$) of order 'n' is given by

$$SK(G) = \sum_{n=1}^{m} (2n-1)$$

Corollary 3.1.2: The SK_1 index of path graph ($P \geq 3$) of order 'n' is given by

$$SK_1(G) = \sum_{n=1}^{m} 2n$$

Theorem 3.2: The AG_1 index of Cycle graph ($C \geq 3$) of order 'n' is given by

$$AG_1(G) = \sum_{n=1}^{m} (n+2)$$

Proof:

The AG_1 index is

$$AG_1(G) = \sum_{u,v \in E(G)} \frac{du + dv}{2\sqrt{du.dv}}$$

If C_n denotes an cycle graph of order n then

$$AG_1(C_3) = 3,\ AG_1(C_4) = 4,\ AG_1(C_5) = 5 \ldots AG_1(P_m) = m$$

Adding all the above equations:

$$AG_1(C_3) + AG_1(C_4) + \ldots + AG_1(C_m) = 3 + 4 + 5 + \ldots\ldots + m$$

$$\sum_{n=1}^{m} AG_1(C_n) = [3+4+5+...+m]$$

$$= \sum_{n=1}^{m} (n+2).$$

Where, n=1, 2, 3… m

Corollary 3.2.1: The SK index of cycle graph ($C \geq 3$) of order 'n' is given by

$$SK(G) = \sum_{n=1}^{m} (2n+4)$$

Corollary 3.2.2: The SK_1 index of cycle graph ($C \geq 3$) of order 'n' is given by

$$SK_1(G) = \sum_{n=1}^{m} (2n+4)$$

Conclusion:

A generalized formula for Arithmetic-Geometric index (AG_1index), *SK* index *and* SK_1index of some graphs are obtained without using computer.

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