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International Journal For Research in  
Applied Science and Engineering Technology



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 12    **Issue:** III    **Month of publication:** March 2024

**DOI:** <https://doi.org/10.22214/ijraset.2024.58813>

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# Augmented Zagreb Index of Corona Product of Some Special Graphs

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**Abstract:** Let  $G(V, E)$  be a simple undirected graph. The Augmented Zagreb Index of a graph  $G$  is defined as  $AZI(G) = \sum_{uv \in E(G)} \left( \frac{du \cdot dv}{du + dv - 2} \right)^3$ , Where  $du$  is the degree of the vertex  $u$  in  $G$ . In this paper, the exact expression for

**Augmented Zagreb Index of different product of graphs like Comb, Wheel, Fan, and Sun graph.**

**Keywords:** Corona product, Augmented Zagreb index.

## I. INTRODUCTION

A graph  $G$  is defined as a pair  $G = (V, E)$ , where  $V$  is a non-empty set of vertices and  $E$  is a set of edges. In this paper graphs are simple and connected. We will deal with finite graph, i.e., both  $|V|$  and  $|E|$  are finite sets. If  $G$  is defined as the Augmented

Zagreb index  $AZI(G) = \sum_{uv \in E(G)} \left( \frac{du \cdot dv}{du + dv - 2} \right)^3$  of a connected graph. Augmented Zagreb index of corona product is expanded

the result of Zagreb index of corona product [9,11]. This research can be expanded to include domination of results and theorems have been verified by the Inverse sum indeg index [1,4,5,6,10,12,13,14]. Some definitions and results are cited as follows [2,3,7,8,16]. This work can also be expanded upon in the context of automata theory [17,18,19] which has a numerous applications. There are numerous application for graph labeling in both undirected [15,21,22,26,27] and directed graphs [20,23,24,25].

## II. MAIN RESULT

Definition 2.1

The Augmented Zagreb index  $AZI(G)$  of a connected graph  $G$  is defined as  $AZI(G) = \sum_{uv \in E(G)} \left( \frac{du \cdot dv}{du + dv - 2} \right)^3$ , where  $u$  and  $v$  are the degrees of the end-vertices of an edge  $uv$ , respectively.

Theorem 2.1

Let  $G_1$  and  $G_2$  be two simple connected graphs then the Augmented Zagreb index of corona product of  $P_n$  and  $K_1$  is

$$\frac{216mn + 1026m + 729n - 3581}{64}$$

Proof:

The structure of Corona product of  $P_n$  and  $K_1$  is shown in fig.2.1 the graph  $P_n \circ K_1$  has  $n(m+1)$  vertices and  $nm + n - 1$  edges.

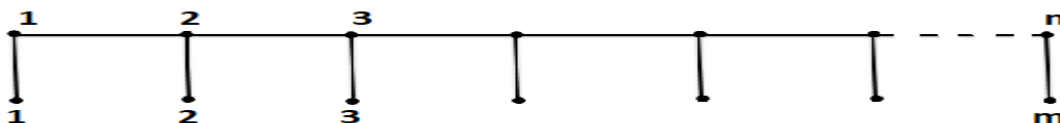


Fig 2.1: Comb  $P_n \circ K_1$

Clearly,  $P_n \circ K_1$  there are  $(1,2)$  – edges,  $(1,3)$  – edges,  $(2,3)$  – edges,  $(3,3)$  – edges, also

$$x_{1,2} = 2, \quad x_{1,3} = m(n-2), \quad x_{2,3} = 2, \quad x_{3,3} = 2m+n-5$$

$$\begin{aligned} AZI(P_n \circ K_1) &= 2\left(\frac{1 \cdot 2}{1+2-2}\right)^3 + m(n-2)\left(\frac{1 \cdot 3}{1+3-2}\right)^3 + 2\left(\frac{2 \cdot 3}{2+3-2}\right)^3 + 2m+n-5\left(\frac{3 \cdot 3}{3+3-2}\right)^3 \\ &= 2(2)^3 + mn - 2m\left(\frac{3}{2}\right)^3 + 2(2)^3 + 2m+n-5\left(\frac{9}{4}\right)^3 \\ &= 16 + mn - 2m\left(\frac{27}{8}\right) + 16 + 2m+n-5\left(\frac{729}{64}\right) \\ &= 32 + \frac{216mn - 432m + 1458m + 729n - 3645}{64} \\ &= \frac{64 + 216mn + 1026m + 729n - 3645}{64} \\ &= \frac{216mn + 1026m + 729n - 3581}{64} \end{aligned}$$

Theorem 2.2

Let  $G_1$  and  $G_2$  be two simple connected graphs then the Augmented Zagreb index of corona product of  $K_1$  and  $C_m$  is

$$\frac{2457m^4n + 2187m^3n + 2187m^2n + 729mn}{64m^3 + 192m^2 + 192m + 64}$$

Proof:

The structure of corona product of  $K_1$  and  $C_m$  is shown in fig.2.2The graph  $K_1 \circ C_m$  has  $n(m+1)$  vertices and  $2nm$  edges.

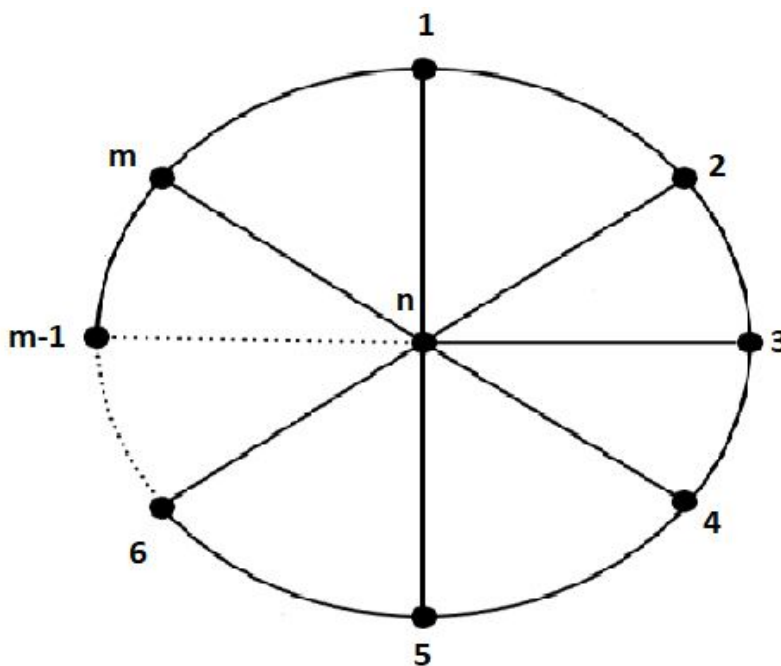


Fig 2.3: Wheel  $K_1 \circ C_m$

Clearly,  $K_1 \circ C_m$  there are  $(3,3)$  – edges,  $(3, m)$  – edges, also

$$x_{3,3} = nm, \quad x_{3,m} = nm.$$

$$\begin{aligned} AZI(K_1 \circ C_m) &= nm \left( \frac{3 \cdot 3}{3 + 3 - 2} \right)^3 + nm \left( \frac{3m}{3 + m - 2} \right)^3 \\ &= nm \left( \frac{729}{64} \right) + nm \left( \frac{27m^3}{(m+1)^3} \right) \\ &= \frac{729nm}{64} + \frac{27nm^4}{m^3 + 3m^2 + 3m + 1} \\ &= \frac{729mn(m^3 + 3m^2 + 3m + 1) + 64(27m^4n)}{64(m^3 + 3m^2 + 3m + 1)} \\ &= \frac{2457m^4n + 2187m^3n + 2187m^2n + 729mn}{64m^3 + 192m^2 + 192m + 64} \end{aligned}$$

### Theorem 2.3

Let  $G_1$  and  $G_2$  be two simple connected graphs then the Augmented Zareb index of corona product of  $C_n$  and  $K_1$  is

$$\frac{1728mn + 5832n}{512}$$

Proof:

The structure of Corona Product of  $C_n$  and  $K_1$  is shown in fig.2.3 The graph  $C_n \circ K_1$  has  $n(m+1)$  vertices and  $n + nm$  edges.

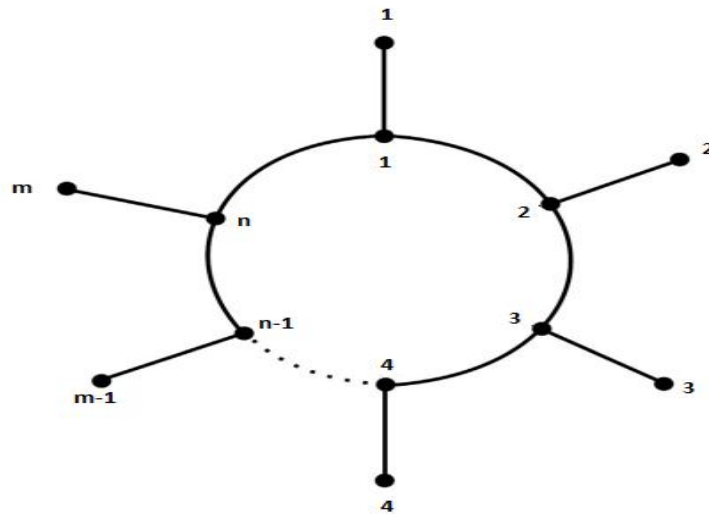


Fig 2.3:Sun  $C_n \circ K_1$

Clearly,  $C_n \circ K_1$  there are  $(1,3)$  – edges,  $(3,3)$  – edges, also

$$x_{1,3} = nm, \quad x_{3,3} = n$$

$$AZI(C_n \circ K_1) = nm \left( \frac{1 \cdot 3}{1 + 3 - 2} \right)^3 + n \left( \frac{3 \cdot 3}{3 + 3 - 2} \right)^3$$

$$\begin{aligned}
 &= nm \left( \frac{27}{8} \right) + n \left( \frac{729}{64} \right) \\
 &= \frac{64(27nm) + 8(729n)}{8 \cdot 64} \\
 &= \frac{1728mn + 5832n}{512}
 \end{aligned}$$

Theorem 2.4

Let  $G_1$  and  $G_2$  be two simple connected graphs then the Augmented Zagreb index of corona product of  $K_1$  and  $P_m$  is

$$\frac{2457m^4n + 3456m^3n - 4374m^2n - 5832mn - 2187n - 4864m^3 + 6144m^2 + 6144m + 2048}{64m^3 + 192m^2 + 192m + 64}$$

Proof:

The structure of corona product of  $K_1$  and  $P_m$  is shown in fig.2.4 The graph  $K_1 \circ P_m$  has  $n(m+1)$  vertices and  $2nm - n$  edges.

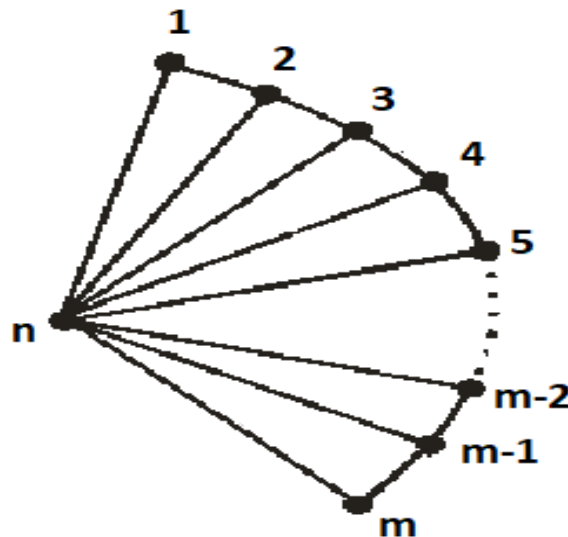


Fig 2.4: Fan  $K_1 \circ P_m$

Clearly,  $K_1 \circ P_m$  there are  $(2,3)$ -edges,  $(2,m)$ -edges,  $(3,3)$ -edges,  $(3,m)$ -edges,

$$\text{also } x_{2,3} = 2, \quad x_{2,m} = 2, \quad x_{3,3} = n(m-3), \quad x_{3,m} = (nm + 2n - 4).$$

$$\begin{aligned}
 AZI(K_1 \circ P_m) &= 2 \left( \frac{2 \cdot 3}{2+3-2} \right)^3 + 2 \left( \frac{2m}{2+m-2} \right)^3 + n(m-3) \left( \frac{3 \cdot 3}{3+3-2} \right)^3 + (nm + 2n - 4) \left( \frac{3m}{3+m-2} \right)^3 \\
 &= 2 \left( \frac{6}{3} \right)^3 + 2 \left( \frac{8m^3}{m^3} \right) + (mn - 3n) \left( \frac{9}{4} \right)^3 + (nm + 2n - 4) \left( \frac{27m^3}{(m+1)^3} \right) \\
 &= 2 \left( \frac{216}{27} \right) + 16 + (mn - 3n) \left( \frac{729}{64} \right) + \frac{27m^4n + 54m^3n - 108m^3}{m^3 + 3m^2 + 3m + 1} \\
 &= 32 + \frac{2457m^4n + 3456m^3n - 4374m^2n - 5832mn - 2187n - 6912m^3}{64m^3 + 192m^2 + 192m + 64}
 \end{aligned}$$



$$= \frac{32(64m^3 + 192m^2 + 192m + 64) + 2457m^4n + 3456m^3n - 4374m^2n - 5832mn - 2187n - 6912m^3}{64m^3 + 192m^2 + 192m + 64}$$

$$= \frac{2457m^4n + 3456m^3n - 4374m^2n - 5832mn - 2187n - 4864m^3 + 6144m^2 + 6144m + 2048}{64m^3 + 192m^2 + 192m + 64}$$

### III. CONCLUSION

In this paper, Augmented Zagreb index of corona product of graphs are discussed. Some special graphs have been proved under Augmented Zagreb index of corona product of graphs. This index can be use as a numerical description with chemical, physical and biological parameters to study about its relationships.

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