Some Degree-based Connectivity Indices of Tadpole Graph

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Abstract*: *Zagreb indices (thought this paper we denote ZbI) a well-known concept introduced in 1972 by I.Gutman and N.Trinajstic denoted as $M_1(G)$ mathematically to study chemical compounds at molecular level. The first two hyper-ZbI of G denoted $HM_1(G)$ and $HM_2(G)$ are well established. In this paper we determine the first ZbI and second ZbI and their polynomial for the Tadpole graph.

Index Terms*: *Hyper-Zagreb indices, Tadpole graph.

I. INTRODUCTION

Throughout this research article we are considering finite, connected, undirected simple graph G. We denote $V(G)$ represent the set consists of vertices and $E(G)$ represent the set consists of edges of respectively. $d_G(v)$ is the number of vertices adjacent to v. We refer [16].

In theoretical chemistry distinctive atomic structures are frequently demonstrated utilizing sub-atomic graphs. Representation of atoms as vertices and bonds as edges respectively and named it as molecular graph.

A sub-atomic diagram is a graph in which, it compares the vertices and edges as to molecules and bonds, individually. In Chemical sciences, synthetic chart hypothesis made exceptionally powerful advancement, and furthermore a topological list for a diagram is utilized to decide some property of the chart sub-atomic by a solitary number. The first ZbI as well as second ZbI of a graph G represents topological indices on the basis of degree with respect to the vertices of G.

By definition the first ZbI of a graph $G$is denoted as $M_1(G)$ and is given by $M_1(G) = \sum_{v \in V(G)} d_G(v)^2$ or $M_1(G) = \sum_{v_1v_2 \in E(G)} [d_G(v_1) + d_G(v_2)]$ and second ZbI of a graph G is denoted as $M_2(G)$ and is given by $M_2(G) = \sum_{v_1v_2 \in E(G)} [d_G(v_1) d_G(v_2)]$. In [15] Gutman and Trinajstic introduced the concept of degree based on topological indices.

In the papers [4, 11, 12 & 19] we obtain the history, applications and characteristics of Zagreb indices.

Shirdel et al. [6] defined first hyper ZbI (HZbI) of G denoted by $HM_1(G)$ and is given by $HM_1(G) = \sum_{v_1v_2 \in E(G)} [d_G(v_1) + d_G(v_2)]^2$ and Farahani et. al. [10], introduced the concept of second HZbI of G denoted as $HM_2(G)$ and is given by $HM_2(G) = \sum_{v_1v_2 \in E(G)} [d_G(v_1) d_G(v_2)]^2$. Authors In [12],[16] and [19] studied these concepts for the comparative advantages of HZbI and other degree based topological indices.

The first Zagreb polynomials (Z Polynomial) of graph G is denoted and defined as $M_1(G,x) = \sum_{v_1v_2 \in E(G)} x^{d_G(v_1)+d_G(v_2)}$ and the second Z polynomials of G gives the equation $M_2(G,x) = \sum_{v_1v_2 \in E(G)} x^{d_G(v_1).d_G(v_2)}$we refer [8]. For further information on ZbI and their polynomial we can go through [1].

The first HZb polynomial of G is well-defined as $HM_1(G,x) = \sum_{v_1v_2 \in E(G)} x^{[d_G(v_1)+d_G(v_2)]^2}$ and second HZb polynomial of G is represented as$HM_2(G)$ and is given by $HM_2(G) = \sum_{v_1v_2 \in E(G)} x^{[d_G(v_1)d_G(v_2)]^2}$.

The concept of Randic index in graph theory for any simple graph structure G can be represented as $\aleph(G)$ and is defined as$\aleph(G) = \sum_{v_1v_2 \in E(G)} \frac{1}{\sqrt{d_G(v_1)d_G(v_2)}}$. This index was proposed by Randic in [7].

Another interesting concept of graph theory named as the sum connectivity index (SCI)for any simple graph G is denoted and defined as $X(G) = \sum_{v_1v_2 \in E(G)} \frac{1}{\sqrt{d_G(v_1)+d_G(v_2)}}$. This topological index was proposed by Zhou and Trinajstic in [20].

In [3], Estrada et.al. introduced concept of chemical graph theory called atom-bond connectivity index (ABCI), which is defined $ABC(G) = \sum_{v_1v_2 \in E(G)} \sqrt{\frac{d_G(v_1)+d_G(v_2)-2}{d_G(v_1)d_G(v_2)}}$.

In this section, we conduct some calculations needed to calculate the indices of Zagreb and their polynomials G. We use the partition set by the vertex $V_a = \{v \in V : d_G(v) = a\}$ and edge $E_b = \{e = v_1v_2 \in E: d_G(v_1) + d_G(v_2) = b\}andE_C^* = \{e = v_1v_2 \in E: d_G(v_1)d_G(v_2) = C\}$.

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II. DEFINITIONS

Definition 2.1: $T_{m,n}$ *denotes the tadpole graph constructed by joining a cycle* C_m *to a path* P_n*. Where* $m \geq 3$ *and* $n \geq 1$*. Tadpole graph is also called as dragon graph.*

Generally, in G, vertex set can be denoted as $V(G)$ *and set of all edges represents* $E(G)$ *respectively. Also, the no. of vertices* $|V(G)| = m + n$ *and no. of edges* $|E(G)| = m + n$.

Case 1:

Vertex and edge partition of tadpole graphs $T_{m,n}$ *where* $m \geq 3$ *and* $n = 1$

We split $V(G)$ *into three subsets* $V_1, V_2 \& V_3$ *as the following three partitions.*

$V_1 = \{v \in V(G); d_1(v) = d_G(v) = 1\};\ |V_1| = 1$

$V_2 = \{v \in V(G);\ d_2(v) = d_G(v) = 2\};\ |V_2| = m - 1$, *and*

$V_3 = \{v \in V(G); d_3(v) = d_G(v) = 3\}; |V_3| = 1$

Similarly, we consider edge set $E(G)$ *partition of of G as* $E_{2,2}, E_{3,1} \& E_{3,2}$*. That is,*

$E_{2,2} = \{uv \in E(G): d_G(u) = d_G(v) = 2\};\ |E_1| = m - 2.$

$E_{3,2} = \{uv \in E(G): d_G(u) = 3, d_G(v) = 2\}; |E_2| = 2.$

$E_{3,1} = \{uv \in E(G): d_G(u) = 3, d_G(v) = 1\}; |E_3| = 1.$

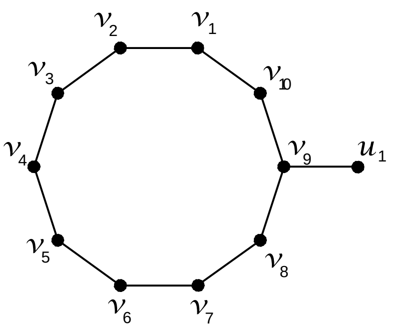

Fig 1: $T_{10,1}$ Graph

Case 2:

Vertex and edge partition of tadpole graphs $T_{m,n}$ where $m \geq 3$ *and* $n > 1$ is considered below.

In this case we split $V(G)$ into three subsets $V_1, V_2 \& V_3$ as the following three partitions.

$V_1 = \{v \in V(G);\ d_1(v) = d_G(v) = 1\};\ |V_1| = 1$

$V_2 = \{v \in V(G); d_2(v) = d_G(v) = 2\};\ |V_2| = m + n - 2$, and

$V_3 = \{v \in V(G); d_3(v) = d_G(v) = 3\}; |V_3| = 1$

Similarly, we consider the partition of edge set $E(G)$ of G as $E_{2,1}, E_{2,2} \& E_{2,3}$. That is,

$E_{2,2} = \{uv \in E(G): d_G(u) = d_G(v) = 2\}; |E_1| = m + n - 4.$

$E_{2,3} = \{uv \in E(G): d_G(u) = 3, d_G(v) = 2\}; |E_2| = 3.$

$E_{2,1} = \{uv \in E(G): d_G(u) = 2, d_G(v) = 1\}; |E_3| = 1.$

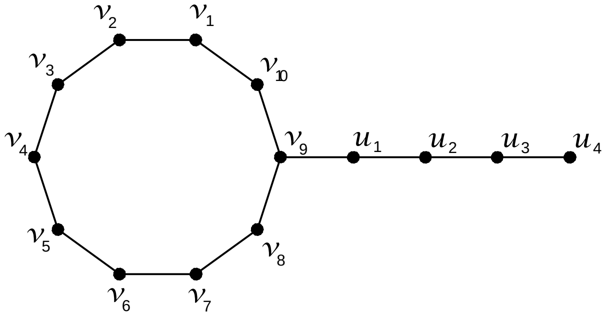

Fig2: $T_{10,4}$ *Graph*

Theorem 2.1: The first HZbI and their polynomial of a Tadpole graph are

$$HM_1(T_{(m,n)}) = 16m + 34 \ \ where\ m \geq 3\ and\ n = 1$$

$$HM_1(T_{m,n}, x) = 2x^{25} + (m-1)x^{16} \ \ where\ m \geq 3\ and\ n = 1$$

Proof: Let $G = T_{m,n}$ be a tadpole graph. Let the vertex set $V(G) = \{v_1, v_2, \ldots, v_n\} \cup \{u_1, u_2, \ldots, u_n\}$. Where $v_i \in V(C_m)$ and $u_i \in P_n$.

We have,

$$HM_1(T_{m,n}) = \sum_{v_1v_2 \in E(G)} [d_G(v_1) + d_G(v_2)]^2$$

$$= \sum_{E_1} [d_2(v_1) + d_2(v_2)]^2 + \sum_{E_2} [d_3(v_1) + d_2(v_2)]^2 + \sum_{E_3} [d_3(v_1) + d_1(v_2)]^2$$

$$= (m-2)(2+2)^2 + 2(3+2)^2 + 1(3+1)^2$$

$$= 16(m-2) + 50 + 16$$

$$HM_1(T_{m,n}) = 16m + 34$$

Now for the first hyper-Zagreb polynomial of $T_{m,n}$, we have

$$HM_1(T_{m,n}, x) = \sum_{v_1v_2 \in E} x^{[d_G(v_1)+d_G(v_2)]^2}$$

$$= \sum_{E_1} x^{[d_2(v_1)+d_2(v_2)]^2} + \sum_{E_2} x^{[d_3(v_1)+d_2(v_2)]^2} + \sum_{E_3} x^{[d_3(v_1)+d_1(v_2)]^2}$$

$$= (m-2)x^{[2+2]^2} + 2x^{[3+2]^2} + x^{[3+1]^2}$$

$$= 2x^{25} + (m-2)x^{16} + x^{16}$$

$$HM_1(T_{m,n}, x) = 2x^{25} + (m-1)x^{16}$$

Theorem 2.2: The first HZbI and their polynomial of a Tadpole graph are

$$HM_1(T_{(m,n)}) = 16m + 16n + 20 \ \ where\ m \geq 3\ and\ > 1$$

$$HM_1(T_{m,n}, x) = 3x^{25} + (m+n-4)x^{16} + x^9 \ \ \ \ where\ \ m \geq 3\ and\ n > 1$$

Proof: Let $G = T_{m,n}$ be a tadpole graph. As defined in theorem 2.1, we consider the vertex set $V(G)$.

Consider

$$HM_1(T_{m,n}) = \sum_{v_1v_2 \in E(G)} [d_G(v_1) + d_G(v_2)]^2$$

$$= \sum_{E_1} [d_2(v_1) + d_2(v_2)]^2 + \sum_{E_2} [d_3(v_1) +$$

d2(v2)2+E3d2v1+d1(v2)2

$$= (m+n-4)(2+2)^2 + 3(3+2)^2 + 1(2+1)^2$$

$$= 16(m+n-4) + 75 + 9$$

$$= 16m + 16n + 20$$

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Now for the first HZb polynomial of $T_{m,n}$, we have

$$HM_1(T_{m,n},x) = \sum_{uv\in E} x^{[d_G(v_1)+d_G(v_2)]^2}$$
$$= \sum_{E_1} x^{[d_2(v_1)+d_2(v_2)]^2} + \sum_{E_2} x^{[d_3(v_1)+d_2(v_2)]^2} + \sum_{E_3} x^{[d_2(v_1)+d_1(v_2)]^2}$$
$$= (m+n-4)x^{(2+2)^2} + 3x^{(3+2)^2} + x^{(2+1)^2}$$
$$= (m+n-4)x^{16} + 3x^{25} + x^9$$
$$HM_1(T_{m,n},.x) = 3x^{25} + (m+n-4)x^{16} + x^9$$

Theorem 2.3: The second HZbI and their polynomial of a Tadpole graph are

$$HM_2(T_{(m,n)}) = 16m + 49 \;\; where\ m > 3\ and\ n = 1$$
$$HM_2(T_{m,n},x) = 3x^{36} + (m-2)x^{16} + x^4\ where\ m > 3\ and\ n = 1$$

Proof: Let $G = T_{m,n}$ be a tadpole graph and define the vertex set $V(G)$ as in theorem 2.1. Consider

$$HM_2(T_{m,n}) = \sum_{v_1v_2\in E} [d_G(v_1)d_G(v_2)]^2$$
$$= \sum_{E_1}[d_2(v_1)d_2(v_2)]^2 + \sum_{E_2}[d_3(v_1)d_2(v_2)]^2 + \sum_{E_3}[d_3(v_1)d_1(v_2)]^2$$
$$= (m-2)(2\times 2)^2 + 2(3\times 2)^2 + (3\times 1)^2$$
$$= 16(m-2) + 72 + 9$$
$$HM_2(T_{m,n}) = 16m + 49$$

Now, for the second hyper-Zagreb polynomial of a $T_{m,n}$, we have

$$HM_2(T_{m,n},x) = \sum_{uv\in E} x^{[d_G(v_1)d_G(v_2)]^2}$$
$$= \sum_{E_1} x^{[d_2(v_1)d_2(v_2)]^2} + \sum_{E_2} x^{[d_3(v_1)d_2(v_2)]^2} + \sum_{E_3} x^{[d_3(v_1)d_1(v_2)]^2}$$
$$= (m-2)x^{[2\times 2]^2} + 2x^{[3\times 2]^2} + x^{[3\times 1]^2}$$
$$= (m-2)x^{16} + 3x^{36} + x^4$$
$$HM_2(T_{m,n},x) = 2x^{36} + (m-2)x^{16} + x^4$$

Theorem 2.4: The second HZbI and their polynomial of a Tadpole graph are

$$HM_2(T_{(m,n)}) = 16m + 16n + 48 \;\; where\ m > 3\ and\ n > 1$$
$$HM_2(T_{m,n},x) = 3x^{36} + (m+n-4)x^{16} + x^4 where\ m > 3\ and\ n > 1$$

Proof: Let $G = T_{m,n}$ be a tadpole graph. As defined in theorem 2.1, we consider the vertex set $V(G)$.

Consider

$$HM_2(T_{m,n}) = \sum_{v_1v_2\in E} [d_G(v_1)d_G(v_2)]^2$$
$$= \sum_{E_1}[d_2(v_1)d_2(v_2)]^2 + \sum_{E_2}[d_3(v_3)d_2(v_2)]^2 + \sum_{E_3}[d_2(v_1)d_1(v_2)]^2$$
$$= (m+n-4)(2\times 2)^2 + 3(3\times 2)^2 + (2\times 1)^2$$
$$= 16(m+n-4) + 108 + 4$$
$$HM_2(T_{m,n}) = 16m + 16n + 48$$

Now, for the second hyper-Zagreb polynomial of a $T_{m,n}$, we have

$$HM_2(T_{m,n},x) = \sum_{v_1v_2\in E} x^{[d_G(v_1)d_G(v_2)]^2}$$
$$= \sum_{E_1} x^{[d_2(v_1)d_2(v_2)]^2} + \sum_{E_2} x^{[d_3(v_1)d_2(v_2)]^2} + \sum_{E_3} x^{[d_2(v_1)d_1(v_2)]^2}$$
$$= (m+n-4)x^{[2\times 2]^2} + 3x^{[3\times 2]^2} + x^{[2\times 1]^2}$$
$$= (m+n-4)x^{16} + 3x^{36} + x^4$$
$$HM_2(T_{m,n},x) = 3x^{36} + (m+n-4)x^{16} + x^4$$

Corollary 2.5: The difference between first and second HZbI of a Tadpole graph $T_{m,n}$where $(m > 3\ and\ n > 1)$ is

$$HM_2(T_{m,n}) - HM_1(T_{m,n}) = 28$$

Corollary 2.6: The difference between first and second HZbI of a Tadpole graph $T_{m,n}$, where $(\ m > 3\ and\ n = 1)$ is

$$HM_2(T_{m,n}) - HM_1(T_{m,n}) = 15$$

Corollary 2.7: The first HZbI of Tadpole graph is equal to sum of the first HZbI of cycle C_m and path P_n. Where $(m > 3\ and\ n > 1)$

$$HM_1(T_{m,n}) = HM_1(C_m) + HM_1(P_m)$$

Corollary 2.8: The first HZbI of Tadpole graph is equal to sum of first HZbI of cycle $C_m$and sixteen times *n*. Where $(m > 3\ and\ n = 1)$

$$HM_1(T_{m,n}) = HM_1(C_m) + 16n$$

Theorem 2.9: The Randic index of Tadpole graph *G* are

$$\aleph(G) = \frac{(m-2)}{2} + 1.394 \;\; where\ m \geq 3\ and\ n = 1$$

Proof: Consider the graph $G = T_{m,n}$is a tadpole graph. We consider the vertex set $V(G)$ as defined in Theorem 2.1. We have,

$$\aleph(G) = \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_G(v_1)d_G(v_2)}}$$
$$= \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_2(v_1)d_2(v_2)}} + \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_3(v_1)d_2(v_2)}} + \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_3(v_1)d_1(v_2)}}$$
$$= (m-2)\frac{1}{\sqrt{2\times 2}} + 2\frac{1}{\sqrt{3\times 2}} + \frac{1}{\sqrt{3\times 1}}$$
$$\aleph(G) = \frac{(m-2)}{2} + 1.394$$

Theorem 2.10: The Randic index Tadpole graphs are

$$\aleph(T_{m,n}) == \frac{(m+n-4)}{2} + 1.932\ where\ m \geq 3\ and\ n > 1$$

Proof: Let $G = T_{m,n}$ be a tadpole graph. Define $V(G)$as in Theorem 2.1. Consider

$$\aleph(G) = \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_G(v_1)d_G(v_2)}}$$
$$= \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_2(v_1)d_2(v_2)}} + \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_3(v_1)d_2(v_2)}} + \sum_{v_1v_2\in E(G)} \frac{1}{\sqrt{d_2(v_1)d_1(v_2)}}$$
$$= (m+n-4)\frac{1}{\sqrt{2\times 2}} + 3\frac{1}{\sqrt{3\times 2}} + \frac{1}{\sqrt{2\times 1}}$$
$$= \frac{(m+n-4)}{2} + 1.932$$
$$\aleph(G) = \frac{(m+n-4)}{2} + 1.932$$

Theorem 2.11: The sum connectivity indexes of tadpole graph are

$$X(G)=\frac{(m-2)}{2}+1.394\ where\ m\geq 3\ and\ n=1$$

Proof: As defined in Theorem 2.1, we consider the set of vertices $V(G)$. We have

$$\aleph(G)=\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_G(v_1)+d_G(v_2)}}$$

$$=\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_2(v_1)+d_2(v_2)}}+\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_3(v_1)+d_2(v_2)}}+\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_3(v_1)+d_1(v_2)}}$$

$$=(m-2)\frac{1}{\sqrt{2+2}}+2\frac{1}{\sqrt{3+2}}+\frac{1}{\sqrt{3+1}}$$

$$\aleph(G)=\frac{(m-2)}{2}+1.394$$

Theorem 2.12: The sum connectivity indexes of tadpole graph are

$$X(G)=\frac{(m+n-4)}{2}+1.919\ where\ m\geq 3\ and\ n>1$$

Proof: We denote sum connectivity $X(G)$ and let $G=T_{m,n}$ be a tadpole graph. Consider

$$X(G)=\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_G(v_1)+d_G(v_2)}}$$

$$=\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_2(v_1)+d_2(v_2)}}+\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_3(v_1)+d_2(v_2)}}+\sum_{v_1v_2\in E(G)}\frac{1}{\sqrt{d_2(v_1)+d_1(v_2)}}$$

$$=(m+n-4)\frac{1}{\sqrt{2+2}}+3\frac{1}{\sqrt{3+2}}+\frac{1}{\sqrt{2+1}}$$

$$=\frac{(m+n-4)}{2}+1.919$$

Theorem 2.13: The atom-bond connectivity index of tadpole graph is

$$ABC(G)=\frac{m+n}{\sqrt{2}}+2.231\ where\ m\geq 3\ and\ n=1$$

Proof: Let $G=T_{m,n}$ be a tadpole graph. Consider

$$ABC(G)=\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_G(v_1)+d_G((v_2)-2}{d_G(v_1)d_G((v_2)}}$$

$$=\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_2(v_1)+d_2((v_2)-2}{d_2(v_1)d_2((v_2)}}+\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_3(v_1)+d_2((v_2)-2}{d_3(v_1)d_2((v_2)}}+\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_2(v_1)+d_1((v_2)-2}{d_G(v_1)d_G((v_2)}}$$

$$=(m-2)\sqrt{\frac{2+2-2}{2\times 2}}+2\sqrt{\frac{3+2-2}{3\times 2}}+\sqrt{\frac{3+1-2}{3\times 1}}$$

$$ABC(G)=\frac{m-2}{\sqrt{2}}+2.231$$

Theorem 2.14: The atom-bond connectivity index of tadpole graph is

$$ABC(G)=\frac{m+n}{\sqrt{2}}\ where\ m\geq 3\ and\ n>1$$

Proof: Let $G=T_{m,n}$ be a tadpole graph. Consider

$$ABC(G)=\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_G(v_1)+d_G((v_2)-2}{d_G(v_1)d_G((v_2)}}$$

$$=\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_2(v_1)+d_2((v_2)-2}{d_2(v_1)d_2((v_2)}}+\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_3(v_1)+d_2((v_2)-2}{d_3(v_1)d_2((v_2)}}+\sum_{v_1v_2\in E(G)}\sqrt{\frac{d_2(v_1)+d_1((v_2)-2}{d_2(v_1)d_1((v_2)}}$$

$$=(m+n-4)\sqrt{\frac{2+2-2}{2\times 2}}+3\sqrt{\frac{3+2-2}{3\times 2}}+\sqrt{\frac{2+1-2}{2\times 1}}$$

$$ABC(G)=\frac{m+n}{\sqrt{2}}$$

III. RESULTS

3.1 First hyper index and polynomial

Sl. No	Notation and Graph	First hyper index	Polynomial
1	$HM_1(T_{(m,n)})$ $where\ m\geq 3\ and\ n>1$	$16m+16n+20$	$3x^{25}+(m+n-4)x^{16}+x^{9}$
2	$HM_1(T_{(m,n)})$ $m\geq 3\ and\ n=1$	$16m+34$	$2x^{25}+(m-1)x^{16}$

3.2 Second hyper index and polynomial

Sl. No	Notation and Graph	Second hyper index	Polynomial
1	$HM_2(T_{(m,n)})$ $where\ m\geq 3\ and\ n>1$	$16m+16n+48$	$3x^{36}+(m+n-4)x^{16}+x^{4}$
2	$HM_2(T_{(m,n)})$ $m\geq 3\ and\ n=1$	$16m+49$	$3x^{36}+(m+n-4)x^{16}+x^{4}$

3.3 The difference between first and second hyper-Zagreb index

Sl. No	Graph	Difference
1	$HM_1(T_{(m,n)})$ $where\ m\geq 3\ and\ n>1$	28
2	$HM_1(T_{(m,n)})$ $m\geq 3\ and\ n=1$	15

3.4Connectivity indices

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Sl.no	Notation and Graph	$m \geq 3$ and $n > 1$	$m \geq 3$ and $n = 1$
1	$\aleph(T_{(m,n)})$	$\frac{(m+n-4)}{2} + 1.932$	$\frac{(m-2)}{2} + 1.394$
2	$X(T_{(m,n)})$	$\frac{(m+n-4)}{2} + 1.919$	$\frac{(m-2)}{2} + 1.394$
3	$ABC(T_{(m,n)})$	$\frac{m+n}{\sqrt{2}}$	$\frac{m-2}{\sqrt{2}} + 2.231$

IV. CONCLUSION

- For the Tadpole graph first HZbIis equal to sum of the first HZbIof cycle and path. Here($G = T_{m,n}$ where $m > 3$ and $n > 1$).
- For the Tadpole graph first HZbI isequal to sum of the first HZbI of cycle and sixteen times n. Here ($G = Tm,n$ where $m>3$ and $n=1$).
- The Randic index of Tadpole graph is equal to the sum connectivity indexes of tadpole graph. where $m \geq 3$ and $n = 1$.

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