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THE EDIZ ECCENTRIC CONNECTIVITY INDEX OF NANOSTAR DENDRIMER $D_3[n]$

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ABSTRACT

A graph G=(V,E) consists of a set of vertices V(G) and a set of edges E(G). In chemical graphs, the vertices and edges of the graph correspond to the atoms of the molecule and chemical bonds, respectively.

The *eccentric connectivity index* is equal to $\xi(G)=\sum_{v\in V} d_v \times \varepsilon(v)$, where $\varepsilon(v)$ is the eccentricity of vertex *v* of *G*. In 2010, *S. Ediz et al.* defined *Ediz eccentric connectivity index* of *G*, ${}^{E}\xi^{c}(G)$, is defined as $\sum_{v\in V(G)} S(v)/\varepsilon(v)$, where *S(v)* is the sum of degrees of all vertices adjacent to vertex *v*. In this paper, we compute the Ediz eccentric connectivity index of an infinite family of Nanostar Dendrimer $D_3[n]$ $(\forall n\geq 1)$.

Keywords: Molecular graph, Eccentric connectivity index, Ediz eccentric connectivity index, Nanostar Dendrimer.

INTRODUCTION

Let $G=(V,E)$ be a graph, where $V(G)$ is a non-empty set of vertices and $E(G)$ is a set of edges. In chemical graphs, the vertices and edges of the graph correspond to the atoms of the molecule and chemical bonds, respectively. For $u\in V(G)$, defined d_u be degree of vertex u. If e is an edge of G, connecting the vertices u and v, then we write $e=uv\in E(G)$ and say u and v are adjacent and if there is a path between all pairs of vertices in G, then is a connected graph.

A molecular descriptors (or *Topological Index*) are a real number related to a molecular graph, which is a graph invariant. For two vertices $u,v\in V(G)$, the distance $d(u,v)$ is equal to the length of any shortest path in G connecting u and v. The *eccentric connectivity index* of the molecular graph G, $\xi(G)$, was proposed by *Sharma, Goswami* and *Madan* [1]. It is defined as

$$\xi(G)=\sum_{v\in V} d_v \times \varepsilon(v)$$

in which $\varepsilon(v)$ denoted the eccentricity of vertex v of G and eccentricity $\varepsilon(v)$ is the largest distance between v and any other vertex u of G or $\varepsilon(v)=Max\{d(v,u)|\forall v\in V(G)\}$. The radius $R(G)$ and diameter $D(G)$ are defined as the minimum and maximum eccentricity among vertices of G, respectively. In other works [1-17]:

$$D(G)=Max_{v\in V(G)}\{d(v,u)|\forall u\in V(G)\}.$$

$$R(G)=Min_{v\in V(G)}\{d(v,u)|\forall u\in V(G)\}.$$

Suppose $S(v)$ as the summation of degrees of all neighbors of vertex v in G. In other words, $S(u)=\sum_{v\in N_G(u)} d_v$ and $N_G(u)=\{v\in V(G)|uv \text{ in } E(G)\}$. In 2010, *S. Ediz* defined *Ediz eccentric connectivity index* of G is defined as

$${}^{E}\xi^{c}(G)=\sum_{v\in V(G)} \frac{S(v)}{\varepsilon(v)}$$

where $S(v)$ is the sum of degrees of all vertices adjacent to vertex v and $\varepsilon(v)$ is the eccentricity of vertex v of G [18-20].

RESULTS AND DISCUSSION

In this section, we compute *Ediz eccentric connectivity index* for an infinite family of Nanostar Dendrimer $D_3[n]$.

Dendrimers are hyper-branched macromolecules, with a rigorously tailored architecture and are one of the main objects of Nano biotechnology. They can be synthesized, in a controlled manner, either by a divergent or a convergent procedure. Dendrimers have gained a wide range of applications in supra-molecular chemistry, particularly in host guest reactions and self-assembly processes. Their applications in chemistry, biology and nano-science are unlimited. Recently, the topological indices of some Dendrimer Nanostars have been investigated in [21-35]. See Figure 1, which show the kind of 3th growth of Dendrimer.

In this paper, we denote the n^{th} growth of Nanostar Dendrimer by $D_3[n]$ $\forall n \in \mathbb{N}$.

From Figure 1 and [31-55], one can see that the Dendrimer Nanostars $D_3[n]$ has $|V(D_3[n])|=21(2^{n+1})-20$ vertices/atoms. Because in the structure of Dendrimer Nanostar $D_3[n]$ (Figure 1), there are $3(2^n)$ vertices/atoms with degree 1 (all Hydrogen atoms), $12(2^{n+1}-1)$ vertices of $D_3[n]$ with degree 2 and $15(2^n)-8$ vertices with degree three. And also, there are $|E(D_3[n])|=½[1\times 3(2^n)+2\times 12(2^{n+1}-1)+3\times 15(2^n)] =24(2^{n+1}-1)$ edges/bonds in the Nanostar Dendrimer $D_3[n]$.

From the structure of Dendrimer Nanostar $D_3[n]$ in Figure 1, we see that an element as Figure 2 (we called "*Leaf*") is add to $D_3[n-1]$ in the n^{th} growth of Nanostar Dendrimer.

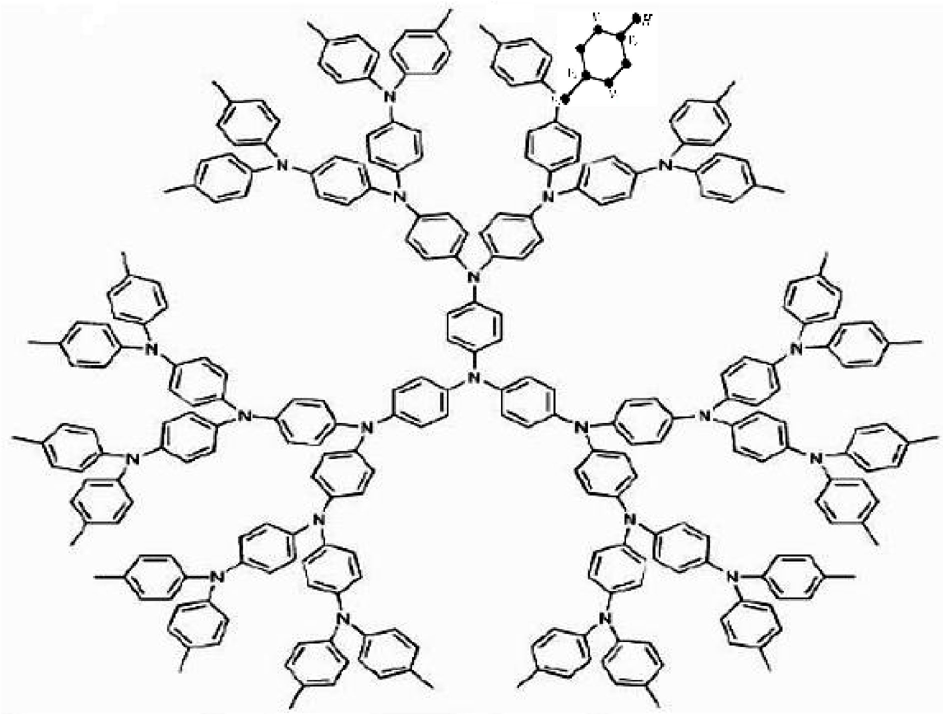

Figure 1: [31-35] An example of the Nanostar Dendrimer $D_3[n]$, $\forall n \in \mathbb{N}$.

In Figure 2, we labeled vertices of an arbitrary added leaf in the n^{th} growth of Nanostar Dendrimer $D_3[n]$. Since the maximum eccentricity of this added leaf is 5, therefore the eccentricity of previous vertices increase 10. Thus, we can compute the eccentricity of all vertices v_1, v_2,.., v_5 (see Table 1).

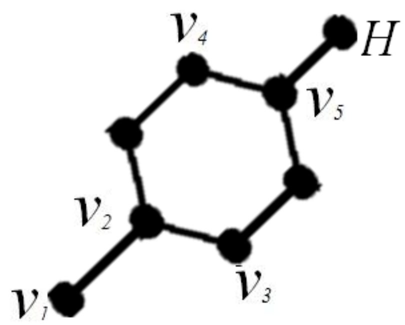

Figure 2: An added leaf in the n^{th} growth of Nanostar Dendrimer $D_3[n]$.

Now, on based the structure of Dendrimer Nanostar $D_3[n]$, one can see that the vertices v_1 (all Nitrogen atoms N), v_2 and v_5 have degree 3 and the vertices v_3 and v_4 have degree 2. Obviously all Hydrogen atoms H have degree 1. The summation of degree $S(v)$ for all vertices of Dendrimer Nanostar $D_3[n]$ (see Figure 3 and Table 1).

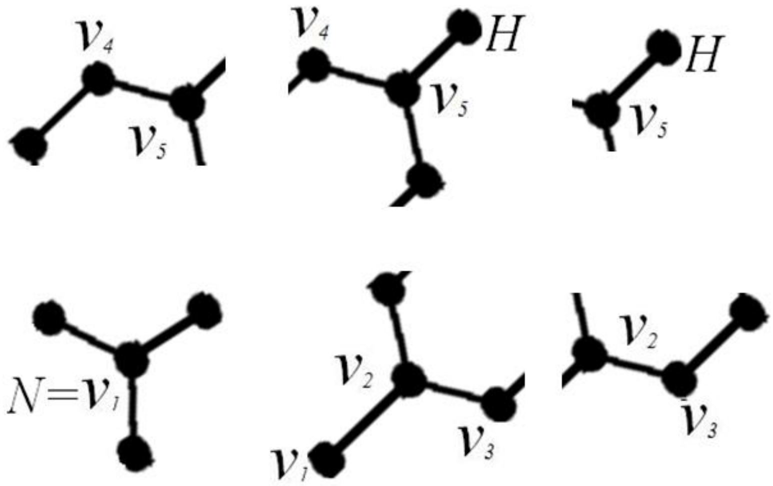

Figure 3: Vertices in an added leaf of $D_3[n]$ with all their adjacent.

Table 1: The number, eccentricity $\varepsilon(v)$ and summation of degree $S(v)$ for vertices of an leaf in Nanostar Dendrimer $D_3[n]$.

Vertices in an added leaf in $D_3[n]$	The eccentricity of v in the i^{th} growth of D3[n]	The summation of degree $S(v)$	The number of these vertices
v_1 (Nitrogen atoms N)	5i+5n+5	9	$3(2^{n-1})$
v_2	5i+5n+6	7	$3(2^n)$
v_3	5i+5n+7	5	$3(2^{n+1})$
v_4	5i+5n+8	5	$3(2^{n+1})$
v_5	5i+5n+9	5	$3(2^n)$
Hydrogen atoms H	10n+10	3	$3(2^n)$

Now, we can compute the Ediz eccentric connectivity index of an infinite family of Nanostar Dendrimer $D_3[n]$ $(\forall n\geq 1)$ as:

$$^{E}\xi^{c}(D_3[n])=\sum_{v\in V(D_3[n])}\frac{S(v)}{\varepsilon(v)}$$

$$=\sum_{\substack{v_1 in D_3[i]\\ i=1,\dots,n}}\frac{S(v_1)}{\varepsilon(v_1)}+\sum_{\substack{v_2 in D_3[i]\\ i=1,\dots,n}}\frac{S(v_2)}{\varepsilon(v_2)}+\sum_{\substack{v_3 in D_3[i]\\ i=1,\dots,n}}\frac{S(v_3)}{\varepsilon(v_3)}+\sum_{\substack{v_4 in D_3[i]\\ i=1,\dots,n}}\frac{S(v_4)}{\varepsilon(v_4)}+\sum_{\substack{v_4 in D_3[i]\\ i=1,\dots,n}}\frac{S(v_4)}{\varepsilon(v_4)}$$

$$+\sum_{\substack{Hydrogen\ atoms\\ of\ D_3[n]}}\frac{S(H)}{\varepsilon(H)}$$

$$=\frac{9}{5n+5}+\sum_{\substack{v_1 in D_3[i]\\ i=2,\dots,n}}\frac{9}{5i+5n+5}+\sum_{\substack{v_2 in D_3[i]\\ i=1,\dots,n}}\frac{7}{5i+5n+6}+\sum_{\substack{v_3 in D_3[i]\\ i=1,\dots,n}}\frac{5}{5i+5n+7}$$

$$+\sum_{\substack{v_4 in D_3[i]\\ i=1,\dots,n}}\frac{5}{5i+5n+8}+\sum_{\substack{v_4 in D_3[i]\\ i=1,\dots,n}}\frac{5}{5i+5n+9}+\sum_{\substack{Hydrogen\ atoms\\ of\quad D_3[n]}}\frac{3}{10(n+1)}$$

$$=\frac{-9}{5(n+2)}+\sum_{i=1}^{n}\frac{27(2^{i-1})}{5i+5n+5}+\sum_{i=1}^{n}\frac{21(2^{i})}{5i+5n+6}+\sum_{i=1}^{n}\frac{15(2^{i+1})}{5i+5n+7}+\sum_{i=1}^{n}\frac{15(2^{i+1})}{5i+5n+8}$$

$$+\sum_{i=1}^{n}\frac{15(2^{i})}{5i+5n+9}+\frac{3(2^{n})}{10(n+1)}$$

$$=\sum_{i=1}^{n}\left(\frac{27(2^{i-1})}{5i+5(n+1)}+\frac{21(2^{i})}{5i+1+5(n+1)}+\frac{15(2^{i+1})}{5i+2+5(n+1)}+\frac{15(2^{i+1})}{5i+3+5(n+1)}+\frac{15(2^{i})}{5i+4+5(n+1)}\right)$$

$$+\frac{3}{5}\left(\frac{2^{n-1}}{n+1}-\frac{3}{n+2}\right)$$

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