Intern. J. Fuzzy Mathematical Archive
Vol. 16, No. 2, 2018, 75-79
ISSN: 2320 –3242 (P), 2320 –3250 (online)
Published on 25 December 2018
www.researchmathsci.org
DOI: http://dx.doi.org/10.22457/ijfma.v16n1a10

International Journal of
Fuzzy Mathematical
Archive

On Multiplicative Minus Indices of Titania Nanotubes

V.R.Kulli

Department of Mathematics
Gulbarga University, Gulbarga 585106, India
e-mail: vrkulli @gmail.com

Received 27 October 2018; accepted 24 November 2018

Abstract. In this paper, we introduce the multiplicative minus index, multiplicative modified minus index, multiplicative minus connectivity index, multiplicative reciprocal minus connectivity index and general multiplicative minus index of a graph and compute exact formulas for titania nanotubes.

Keywords: multiplicative minus indices, titania nanotube.

AMS Mathematics Subject Classification (2010): 05C05, 05C07, 05C90

1. Introduction

Let G be a finite, simple connected graph with vertex set $V(G)$ and edge set $E(G)$. The degree $d_G(v)$ of a vertex v is the number of vertices adjacent to v. For additional definitions and notations, the reader may refer to [1].

A molecular graph is a graph whose vertices correspond to the atoms and the edges to the bonds. Chemical graph theory has an important effect on the development of chemical sciences. A single number that can be used to characterize some property of the graph of molecular is called a topological index. Several topological indices have been considered in Theoretical Chemistry, see [2].

In [3], Albertson introduced the irregularity index as

$$Alb(G) = \sum_{uv \in V(G)} \left| d_G(u) - d_G(v) \right|.$$

In [4], this index is referred to as the minus index.

In this paper, we introduce the following multiplicative minus topological indices:

The multiplicative minus index of a graph G is defined as

$$MiII(G) = \prod_{uv \in E(G)} \left| d_G(u) - d_G(v) \right|. \tag{1}$$

The multiplicative square minus index of a graph G is defined as

$$SMiII(G) = \prod_{uv \in E(G)} \left[\left| d_G(u) - d_G(v) \right| \right]^2. \tag{2}$$

The multiplicative modified minus index of a graph G is defined as

$$ {}^{m}M_{i}II(G)=\prod_{uv\in E(G)}\frac{1}{\left|d_G(u)-d_G(v)\right|}. \tag{3}$$

The multiplicative minus connectivity index of a graph G is defined as

$$ MicII(G)=\prod_{uv\in E(G)}\frac{1}{\sqrt{\left|d_G(u)-d_G(v)\right|}}. \tag{4}$$

The multiplicative reciprocal minus connectivity index of a graph G is defined as

$$ RMicII(G)=\prod_{uv\in E(G)}\sqrt{\left|d_G(u)-d_G(v)\right|}. \tag{5}$$

The general multiplicative minus index of a graph G is defined as

$$ M_i^a II(G)=\prod_{uv\in E(G)}\left[\left|d_G(u)-d_G(v)\right|\right]^a \tag{6}$$

Recently, some new multiplicative topological indices were studied, for example, in [5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20].

A study of titania nanotubes has received much attention in Mathematical and Chemical literature (see 21,22,23). In this paper, the multiplicative minus topological indices for titania nanotubes are determined.

2. Titania nanotubes

Titania nanotubes denoted by $TiO_2[m, n]$ for $m, n \in N$, in which m is the number of octagons C_8 in a row and n is the number of octagons C_8 in a column. The graph of TiO_2 $[m, n]$ is shown in Figure 1.

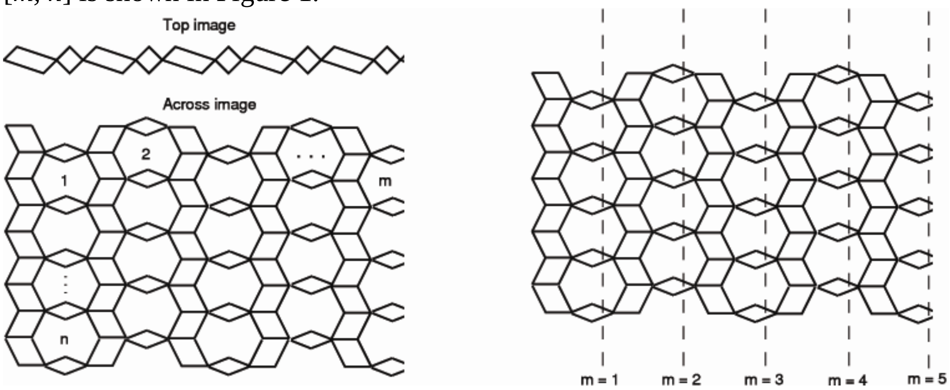

Figure 1: The graph of TiO_2 $[m, n]$ nanotube

Let G be the graph of a titania nanotube TiO_2 $[m, n]$ with $6n$ $(m+1)$ vertices and $10mn + 8n$ edges. In G, by calculation, there are four types of edges based on the degree of end vertices of each edge as given in Table 1.

$d_G(u), d_G(v)\backslash uv \in E(G)$	(2, 4)	(2, 5)	(3, 4)	(3, 5)
Number of edges	$6n$	$4mn+2n$	$2n$	$6mn – 2n$

Table 1: Edge partition of TiO_2 $[m, n]$

In the following theorem, we compute the multiplicative minus index of TiO_2 $[m,n]$.

Theorem 1. The multiplicative minus index of a titania nanotube TiO_2 $[m, n]$ is

$$MiII(TiO_2) = 2^{6mn+4n} \times 3^{4mn+2n}.$$

Proof: Let $G = TiO_2$ $[m, n]$ be the graph of a titania nanotube. By using equation (1) and Table 1, we derive

$$\begin{aligned} MiII(TiO_2) &= \prod_{uv \in E(G)} \left| d_G(u) - d_G(v) \right| \\ &= (|2-4|)^{6n} \times (|2-5|)^{4mn+2n} \times (|3-4|)^{2n} \times (|3-5|)^{6mn-2n} \\ &= 2^{6mn+4n} \times 3^{4mn+2n} \end{aligned}$$

In the following theorem, we compute the multiplicative square minus index of $TiO_2[m,n]$.

Theorem 2. The multiplicative square minus index of a titania nanotube TiO_2 is

$$SMiII(TiO_2) = 2^{12mn+8n} \times 3^{8mn+4n}.$$

Proof: Let $G = TiO_2$ $[m,n]$ be the graph of a titania nanotube. By using equation (2) and Table 1, we deduce

$$\begin{aligned} SMiII(TiO_2) &= \prod_{uv \in E(G)} \left[d_G(u) - d_G(v) \right]^2 \\ &= (2-4)^{2\times 6n} \times (2-5)^{2(4mn+2n)} \times (3-4)^{2\times 2n} \times (3-5)^{2(6mn-2n)} \\ &= 2^{12mn+8n} \times 3^{8mn+4n} \end{aligned}$$

In the following theorem, we compute the multiplicative modified minus index of TiO_2 $[m,n]$.

Theorem 3. The multiplicative modified minus index of a titania nanotube TiO_2 is

$$^{m}M_iII(TiO_2) = \left(\frac{1}{2}\right)^{6mn+4n} \times \left(\frac{1}{3}\right)^{4mn+2n}.$$

Proof: Let $G=TiO_2$ $[m, n]$ be the graph of a titania nanotube. By using equation (3) and Table 1, we obtain

$$\begin{aligned} ^{m}M_iII(TiO_2) &= \prod_{uv \in E(G)} \frac{1}{\left| d_G(u) - d_G(v) \right|} \\ &= \left(\frac{1}{|2-4|}\right)^{6n} \times \left(\frac{1}{|2-5|}\right)^{4mn+2n} \times \left(\frac{1}{|3-4|}\right)^{2n} \times \left(\frac{1}{|3-5|}\right)^{6mn-2n} \\ &= \left(\frac{1}{2}\right)^{6mn+4n} \times \left(\frac{1}{3}\right)^{4mn+2n}. \end{aligned}$$

In the following theorem, we compute the multiplicative minus connectivity index of TiO_2 $[m, n]$.

Theorem 4. The multiplicative minus connectivity index of $TiO_2[m,n]$ nanotubes is

$$MicII\left(TiO_2\right)=\left(\frac{1}{2}\right)^{3mn+4n}\times\left(\frac{1}{3}\right)^{2mn+n}.$$

Proof: Let $G=TiO_2$ $[m, n]$ be the graph of a titania nanotube. By using equation (4) and Table 1, we have

$$MicII\left(TiO_2\right)=\prod_{uv\in E(G)}\frac{1}{\sqrt{\left|d_G(u)-d_G(v)\right|}}$$

$$=\left(\frac{1}{\sqrt{|2-4|}}\right)^{6n}\times\left(\frac{1}{\sqrt{|2-5|}}\right)^{4mn+2n}\times\left(\frac{1}{\sqrt{|3-4|}}\right)^{2n}\times\left(\frac{1}{\sqrt{|3-5|}}\right)^{6mn-2n}$$

$$=\left(\frac{1}{2}\right)^{3mn+4n}\times\left(\frac{1}{3}\right)^{2mn+n}.$$

In the following theorem, we determine the multiplicative reciprocal minus connectivity index of a titania nanaotube TiO_2 $[m, n]$.

Theorem 5. The multiplicative reciprocal minus connectivity index of TiO_2 $[m,n]$ is

$$RMicII\left(TiO_2\right)=2^{3mn+2n}\times 3^{2mn+n}.$$

Proof: Let $G=TiO_2$ $[m, n]$ be the graph of a titania nanotube. By using equation (5) and Table 1, we deduce

$$RMicII\left(TiO_2\right)=\prod_{uv\in E(G)}\sqrt{\left|d_G(u)-d_G(v)\right|}$$

$$=\left(\sqrt{|2-4|}\right)^{2\times 6n}\times\left(\sqrt{|2-5|}\right)^{4mn+2n}\times\left(\sqrt{|3-4|}\right)^{2n}\times\left(\sqrt{|3-5|}\right)^{6mn-2n}=2^{3mn+2n}\times 3^{2mn+n}.$$

In the following, we compute the general multiplicative minus index of TiO_2 $[m, n]$.

Theorem 6. The general multiplicative minus index of TiO_2 $[m,n]$ is

$$M_i^a II(G)=(2)^{a(6mn+4n)}\times 3^{a(4mn+2n)}.$$

Proof: Let $G=TiO_2$ $[m, n]$ be the graph of a titania nanotube. By using equation (6) and Table 1, we obtain

$$M_i^a II(G)=\prod_{uv\in E(G)}\left[\left|d_G(u)-d_G(v)\right|\right]^a$$

$$=(|2-4|)^{6n}\times(|2-5|)^{4mn+2n}\times(|3-4|)^{2n}\times(|3-5|)^{6mn-2n}$$

$$=(2)^{a(6mn+4n)}\times(3)^{a(4mn+2n)}$$

REFERENCES

1. V.R.Kulli, *College Graph Theory*, Vishwa International Publications, Gulbarga, India (2012).
2. I.Gutman and O.E.Polansky, *Mathematical Concepts in Organic Chemistry,* Springer, Berlin (1986).
3. M.O.Albertson, The irregularity of a graph, *Ars. Cobmin.*, 46 (1997) 219-225.
4. V.R.Kulli, Computation of some minus indices of titania nanotubes, *International Journal of Current Research in Science and Technology*, 4(12) (2018) 9-13.

5. M.Azari and A.Iranmanesh, Some inequalities for the multiplicative sum Zagreb index of graph operation, *Journal of Mathematical Inequalities,* 9(3) (2015) 727-738.
6. K.C.Das, A.Yurttas, M.Togan, A.S.Cevik and N.Cangul, The multiplicative Zagreb indices of graph operations, *Journal of Inequalities and Applications,* 90 (2013) 1-14.
7. M.Eliasi, A simple approach to order the multiplicative Zagreb indices of connected graph, *Transactions on Combinatorics*, 1(4) (2012) 17-24.
8. I.Gutman, Multiplicative Zagreb indices of trees, *Bull. Soc. Math. Banja Luka*, 18 (2011) 17-23.
9. V.R.Kulli, Some new fifth multiplicative Zagreb indices of PAMAM dendrimers, *Journal of Global Research in Mathematics*, 5(2) (2018) 82-86.
10. V.R.Kulli, Multiplicative connectivity reverse indices of two families of dendrimer nanostars, *International Journal of Current Research in Life Sciences*, 7(2) (2018) 1102-1108.
11. V.R.Kulli, Degree based multiplicative connectivity indices of nanostructures, *International Journal of Current Advanced Research,* 7,2(K) (2018) 10359-10362.
12. V.R.Kulli, On fifth multiplicative Zagreb indices of tetrathiafulvalene and POPAM dendrimers, *International Journal of Engineering Sciences and Research Technology*, 7(3) (2018) 471-479.
13. V.R.Kulli, Multiplicative connectivity Banhatti indices of benzenoid systems and polycyclic aromatic hydrocarbons, *Journal of Computer and Mathematical Sciences*, 9(3) (2018) 212-220.
14. V.R.Kulli, General multiplicative ve-degree indices of dominating oxide and regular triangulate oxide networks, *Journal of Global Research in Mathematical Archives,* 5(5) (2018) 60-64.
15. V.R.Kulli, Multiplicative connectivity ve-degree indices of dominating oxide and regular triangulate oxide networks, *International Journal of Current Advanced Research,* 7, 4(J) (2018) 11961-11964.
16. V.R.Kulli, Edge version of multiplicative atom bond connectivity index of certain nanotubes and nanotorus, *International Journal of Mathematics and its Applications,* 6(1-E) (2018) 977-982.
17. V.R.Kulli, Multiplicative connectivity Banhatti indices of dendrimer nanostars, *Journal of Chemistry and Chemical Sciences,* 8(6) (2018) 964-973.
18. V.R.Kulli, Multiplicative connectivity *KV* indices of dendrimers, *Journal of Mathematics and Informatics,* 15(1) (2019) 1-7.
19. V.R.Kulli, Some multiplicative reduced indices of certain nanostructures, *International Journal of Mathematical Archive,* 9(11) (2018) 1-5.
20. V.R.Kulli, Multiplicative Dakshayani indices, *International Journal of Engineering Sciences and Research Technology,* 7(10) (2018) 75-81.
21. N.De, On molecular topological properties of TiO_2 nanotubes, *Journal of Nanoscience*, 2016, Article ID 1028031, 5 pages.
22. V.R.Kulli, Computation of general topological indices for titania nanotubes, *International Journal of Mathematical Archive*, 7(12), (2016) 33-38.
23. V.R.Kulli, Computation of some Gourava indices of titania nanotubes, *International Journal of Fuzzy Mathematical Archive*, 12(2) (2017) 75-81.