Available online at http://www.ijcrls.com

International Journal of Current Research in Life Sciences
Vol. 07, No. 05, pp.2110-2116, May, 2018

ISSN: 2319-9490

RESEARCH ARTICLE

REVAN INDICES AND THEIR POLYNOMIALS OF CERTAIN RHOMBUS NETWORKS

***Kulli, V.R.**

Department of Mathematics, Gullbarga University, Gulbarga, India

Received 16th March, 2018; Accepted 21st April, 2018; Published 18th May, 2018

ABSTRACT

In this paper, we introduce the first and second Revan polynomials of a molecular graph. We compute the first and second Revan indices and their polynomials of rhombus silicate and rhombus oxide networks. Also we determine the first Revan vertex index and third Revan index and their polynomials of rhombus silicate and rhombus oxide networks.

Key words: Revan indices, Rhombus silicate network, Rhombus oxide network.

Citation: Kulli, V.R., 2018. "Revan indices and their polynomials of certain rhombus networks" *International Journal of Current Research in Life Sciences*, 7, (05), 2110-2116.

INTRODUCTION

We consider only finite connected undirected without loops and multiple edges. Let G be a graph with vertex set $V(G)$ and edge set $E(G)$. Let $d_G(v)$ denote the number of vertices adjacent to v. Let $\Delta(G)(\ \delta(G))$ denote the maximum (minimum) degree among the vertices of G. The Revan vertex degree of a vertex v in G is defined as $r_G(v)=\Delta(G) + \delta(G) - d_G(v)$. The Revan edge connecting the Revan vertices u and v will be denoted by uv. For other undefined notations and terminologies, we refer [Kulli, 2012].
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 such topological indices have been considered in Theoretical Chemistry and have found some applications, especially in QSPR/QSAR study, see [Todeschini and Consonni,2009].

In [Kulli,2017], the first and second Revan indices of a graph G are defined as

$$R_1(G)=\sum_{uv\in E(G)}\left[r_G(u)+r_G(v)\right], \qquad R_2(G)=\sum_{uv\in E(G)} r_G(u)r_G(v).$$

Considering Revan indices, we define the first and second Revan polynomials of a graph G as

$$R_1(G,x)=\sum_{uv\in E(G)} x^{r_G(u)+r_G(v)}, \qquad R_2(G,x)=\sum_{uv\in E(G)} x^{r_G(u)r_G(v)}.$$

The first Revan vertex index [Kulli,2017] of a graph G is defined as

$$R_{01}(G)=\sum_{u\in V(G)} r_G(u)^2.$$

The third Revan index [Kulli,2017] of a graph G is defined as

$$R_3(G)=\sum_{uv\in E(G)}\left|r_G(u)-r_G(v)\right|.$$

Considering the first Revan vertex index, we define the first Revan vertex polynomial as

$$R_{01}(G,x)=\sum_{u\in V(G)} x^{r_G(u)^2}.$$

Corresponding author:* **Kulli, V.R.,
Department of Mathematics, Gullbarga University, Gulbarga, India

Considering the third Revan index, we define the third Revan polynomial as

$$R_3(G) = \sum_{uv \in E(G)} x^{|r_G(u) - r_G(v)|}.$$

Recently other Revan indices were studied, for example, in (Kulli 2017) and also many topological indices were studied, for example, in (Kulli, 2016; Kulli, 2017). In this paper, some Revan indices and their polynomials of rhombus silicate networks and rhombus oxide networks are determined. For rhombus silicate networks and rhombus oxide networks see [19] and references cited therein.

Results for Rhombus Silicate Networks

We consider a family of rhombus silicate networks. A rhombus silicate network is symbolized by $RHSL_n$. A 3-dimensional rhombus silicate network is depicted in Figure 1.

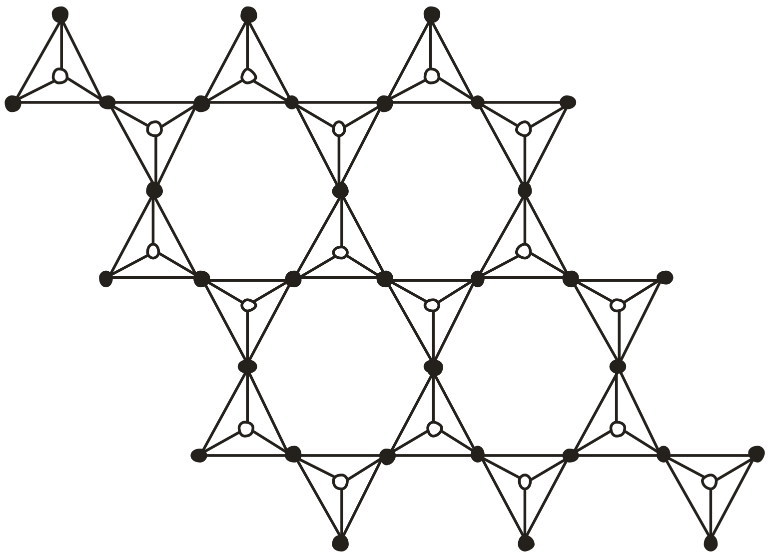

Figure 1. A 3-dimensional rhombus silicate network

In the following theorem, we compute the first Revan vertex index and its polynomial of rhombus silicate network.

Theorem 1. Let G be the graph of rhombus silicate network $RHSL_n$. Then

$$R_{01}(RHSL_n) = 99n^2 + 126n. \tag{1}$$

$$R_{01}(RHSL_n, x) = (2n^2 + 4n)x^{36} + (3n^2 - 2n)x^9. \tag{2}$$

Proof: Let G be the graph of $RHSL_n$. By algebraic method, we obtain that G has $5n^2+2n$ vertices. From Figure 1, it is easy to see that the vertices of $RHSL_n$ are either of degree 3 or 6. Thus $\Delta(G) = 6$, $\delta(G) = 3$. We partition $V(RHSL_n)$ into two sets, vertices of degree 3 and 6 respectively.

$V_3 = \{u \in V(G)|\ d_G(u) = 3\}$, $|V_3| = 2n^2 + 4n$.
$V_6 = \{u \in V(G)|\ d_G(u) = 6\}$, $|V_6| = 3n^2 - 2n$.
Clearly, we have $\Delta(G) + \delta(G) = 9$. Thus $r_G(u) = 9 - d_G(u)$.

Thus there are two types of Revan vertices as follows.

$V_{r6} = \{u \in V(G)|\ r_G(u) = 6\}$, $|V_{r6}| = 2n^2 + 4n$.
$V_{r3} = \{u \in V(G)|\ d_G(u) = 3\}$, $|V_{r3}| = 3n^2 - 2n$.

1) To compute $R_{01}(RHSL_n)$, we see that

$$R_{01}(G) = \sum_{u \in V(G)} r_G(u)^2 + \sum_{u \in V_{r6}} r_G(u)^2 + \sum_{u \in V_{r3}} r_G(u)^2$$
$$= \left(2n^2 + 4n\right)6^2 + \left(3n^2 - 2n\right)3^2 = 99n^2 + 126n.$$

2) To compute $R_{01}(RHSL_n, x)$, we see that

$$R_{01}(G,x)=\sum_{u\in V(G)} x^{r_G(u)^2}=\sum_{u\in V_{r6}} x^{r_G(u)^2}+\sum_{u\in V_{r3}} x^{r_G(u)^2}$$
$$=\left(2n^2+4n\right)x^{6^2}+\left(3n^2-2n\right)x^{3^2}$$
$$=\left(2n^2+4n\right)x^{36}+\left(3n^2-2n\right)x^{9}.$$

We compute the value of $R_1(RHSL_n)$, $R_2(RHSL_n)$, $R_3(RHSL_n)$ for rhombus silicate networks.

Theorem 2. Let $RHSL_n$ be the rhombus silicate network. Then

$R_1(RHSL_n) = 90n^2 + 36n$. (1)

$R_2(RHSL_n) = 162n^2 + 144n + 18$. (2)

$R_3(RHSL_n) = 18n^2 + 12n - 12$. (3)

Proof: Let G be the graph of rhombus silicate network. By calculation, we obtain that G has $12n^2$ edges. In $RHSL_n$, by algebraic method, there are three types of edges based on the degree of the end vertices of each edge as follows:

$E_{33} = \{uv \in E(G) | d_G(u) = d_G(v) = 3\}$, $|E_{33}| = 4n + 2$.

$E_{36} = \{uv \in E(G) | d_G(u) = 3, d_G(v) = 6\}$, $|E_{36}| = 6n^2 + 4n - 4$.

$E_{66} = \{uv \in E(G) | d_G(u) = d_G(v) = 6\}$, $|E_{66}| = 6n^2 - 8n + 2$.

Clearly we have $\Delta(G) = 6$, $\delta(G) = 3$. Thus $r_G(u) = 9 - d_G(u)$. Thus there are three types of Revan edges based on the degree of the end revan vertices of each revan edge as follows:

$RE_{66} = \{uv \in E(G) | r_G(u) = r_G(v) = 6\}$, $|RE_{66}| = 4n + 2$.

$RE_{63} = \{uv \in E(G) | r_G(u) = 6, r_G(v) = 3\}$, $|RE_{63}| = 6n^2 + 4n - 4$.

$RE_{33} = \{uv \in E(G) | d_G(u) = d_G(v) = 3\}$, $|RE_{33}| = 6n^2 - 8n + 2$.

(1) We compute $R_1(RHSL_n)$, we see that

$$R_1(G)=\sum_{uv\in E(G)}\left[r_G(u)+r_G(v)\right]=\sum_{RE_{66}}\left[r_G(u)+r_G(v)\right]+\sum_{RE_{63}}\left[r_G(u)+r_G(v)\right]+\sum_{RE_{33}}\left[r_G(u)+r_G(v)\right]$$
$$=12(4n+2)+9\left(6n^2+4n-4\right)+6\left(6n^2-8n+2\right)$$
$$=90n^2+36n.$$

(2) To compute $R_2(RHSL_n)$, we see that

$$R_2(G)=\sum_{uv\in E(G)} r_G(u)r_G(v)=\sum_{RE_{66}} r_G(u)r_G(v)+\sum_{RE_{63}} r_G(u)r_G(v)+\sum_{RE_{33}} r_G(u)r_G(v)$$
$$=36(4n+2)+18\left(6n^2+4n-4\right)+9\left(6n^2-8n+2\right)$$
$$=162n^2+144n+18.$$

(3) To compute $R_3(RHSL_n)$ we see that

$$R_3(G)=\sum_{uv\in E(G)}\left|r_G(u)-r_G(v)\right|=\sum_{RE_{66}}\left|r_G(u)-r_G(v)\right|+\sum_{RE_{63}}\left|r_G(u)-r_G(v)\right|+\sum_{RE_{33}}\left|r_G(u)-r_G(v)\right|$$
$$=0\times(4n+2)+3\left(6n^2+4n-4\right)+0\times\left(6n^2-8n+2\right)=18n^2+12n-12.$$

In the following theorem, we compute the value of $R_1(RHSL_n, x)$, $R_2(RHSL_n, x)$, $R_3(RHSL_n, x)$ for rhombus silicate networks.
Theorem 3. Let $RHSL_n$ be the rhombus silicate network. Then

$$R_1\left(RHSL_n,x\right)=(4n+2)x^{12}+\left(6n^2+4n-4\right)x^9+\left(6n^2-8n+2\right)x^6. \quad (1)$$

$$R_2\left(RHSL_n,x\right)=\left(4n+2\right)x^{36}+\left(6n^2+4n-4\right)x^{18}+\left(6n^2-8n+2\right)x^{9}. \tag{2}$$

$$R_3\left(RHSL_n,x\right)=\left(6n^2+4n-4\right)x^{3}+\left(6n^2-4n+4\right). \tag{3}$$

Proof: (1) Using the partition of the revan edge set, we can apply the formula of the first Revan polynomial of *G.* Since

$$R_1\left(G,x\right)=\sum_{uv\in E(G)} x^{r_G(u)+r_G(v)},$$

this implies that

$$R_1\left(RHSL_n,x\right)=\left(4n+2\right)x^{12}+\left(6n^2+4n-4\right)x^{9}+\left(6n^2-8n+2\right)x^{6}.$$

(2) Using the partition of the revan edge set, we can apply the formula of the second Revan polynomial of *G*.

Since $R_2\left(G,x\right)=\sum_{uv\in E(G)} x^{r_G(u)r_G(v)}$,

this implies that

$$R_2\left(RHSL_n,x\right)=\left(4n+2\right)x^{36}+\left(6n^2+4n-4\right)x^{18}+\left(6n^2-8n+2\right)x^{9}.$$

(3) Using the partition of the revan edge set, we can apply the formula of the third Revan index of G

Since $R_3\left(G,x\right)=\sum_{uv\in E(G)} x^{\left|r_G(u)-r_G(v)\right|}$,

this implies that

$$R_3\left(RHSL_n,x\right)=\left(4n+2\right)x^{0}+\left(6n^2+4n-4\right)x^{3}+\left(6n^2-8n+2\right)x^{0}.$$
$$=\left(6n^2+4n-4\right)x^{3}+\left(6n^2-4n+4\right).$$

Results for Rhombus Oxide Networks

We consider a family of rhombus oxide networks. A rhombus oxide network of dimension *n* is denoted by $RHOX_n$. A rhombus oxide network of dimension 3 is depicted in Figure 2.

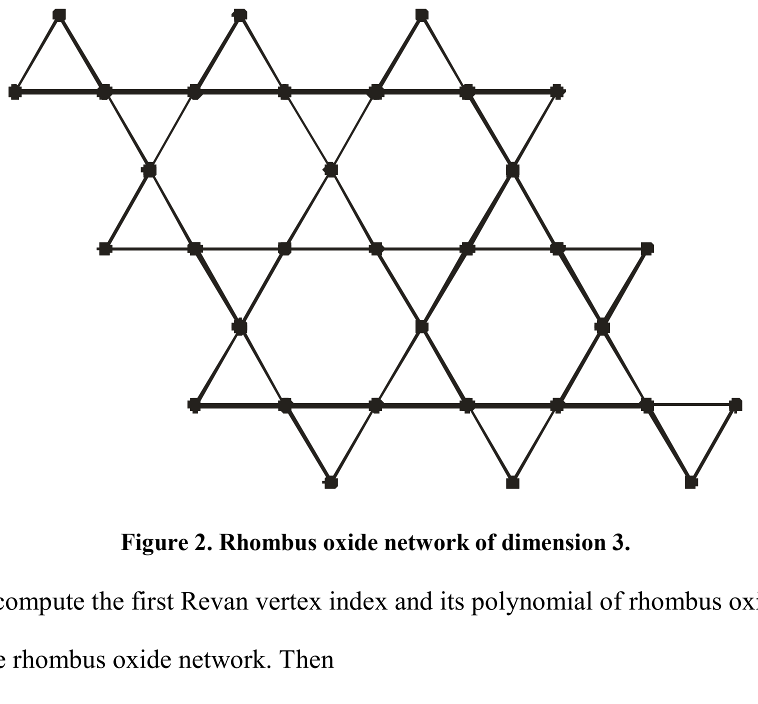

Figure 2. Rhombus oxide network of dimension 3.

In the following theorem, we compute the first Revan vertex index and its polynomial of rhombus oxide network.

Theorem 4. Let $RHOX_n$ be the rhombus oxide network. Then

$$R_{01}(RHOX_n) = 12n^2 + 56n. \tag{1}$$

$R_{01}(RHOX_n, x) = 4nx^{16} + (3n^2 - 2n)x^4.$ (2)

Proof: Let H be the graph of rhombus oxide network. By calculation, we obtain that H has $3n^2+2n$ vertices. From Figure 2, it is easy to see that the vertices of $RHOX_n$ are either of degree 2 or 4. Thus $\Delta(H)=4$ and $\delta(H)=2$. We partition vertex set $V(RHOX_n)$ into two sets, vertices of degree 2 and 4 respectively.

$V_2 = \{u \in V(H)| d_H(u) = 2\}, \ |V_2| = 4n.$

$V_4 = \{u \in V(H)| d_H(u) = 4\}, \ |V_4| = 3n^2 - 2n.$

Clearly, we have $\Delta(H) + \delta(H) = 6$. Thus $r_H(u) = 6 - d_H(u)$.
Thus there are two types of Revan vertices as follows:

$V_{r4} = \{u \in V(H)| r_H(u) = 4\}, \ |V_{r4}| = 4n.$

$V_{r2} = \{u \in V(H)| r_H(u) = 2\}, \quad |V_{r2}| = 3n^2 - 2n.$

(1)Compute $R_{01}(RHOX_n)$, we see that

$$R_{01}(H) = \sum_{u \in V(H)} r_H(u)^2 = \sum_{u \in V_{r4}} r_H(u)^2 + \sum_{u \in V_{r2}} r_H(u)^2$$
$$= 4n \times 4^2 + (3n^2 - 2n) \times 2^2 = 12n^2 + 56n.$$

(2)To compute $R_{01}(RHOX_n, x)$, we see that

$$R_{01}(H, x) = \sum_{u \in V(H)} x^{r_H(u)^2} = \sum_{u \in V_{r4}} x^{r_H(u)^2} + \sum_{u \in V_{r2}} x^{r_H(u)^2}$$
$$= 4nx^{4^2} + (3n^2 - 2n)x^{2^2} = 4nx^{16} + (3n^2 - 2n)x^4.$$

In the following theorem, we compute the value of $R_1(RHOX_n)$, $R_2(RHOX_n)$, $R_3(RHOX_n)$ for rhombus oxide networks.

Theorem 5. Let $RHOX_n$ be the rhombus oxide network. Then,

$R_1(RHOX_n) = 24n^2 + 16n.$ (1)

$R_2(RHOX_n) = 24n^2 + 32n + 8.$ (2)

$R_3(RHOX_n) = 16n - 8.$ (3)

Proof: Let H be the rhombus oxide network. By calculation, we obtain that H has $6n^2$ edges. In $RHOX_n$, by algebraic method, there are three types of edges based on the degree of the end vertices of each edge follows:

$E_{22} = \{uv \in E(H)| d_H(u) = d_H(v) = 2\}, \ |E_{22}| = 2.$

$E_{24} = \{uv \in E(H)| d_H(u) = 2, d_H(v) = 4\}, \ |E_{24}| = 8n - 4.$

$E_{44} = \{uv \in E(H)| d_H(u) = d_G(v) = 4\}, \ |E_{44}| = 6n^2 - 8n + 2.$

Clearly we have $\Delta(H)=4$ and $\delta(H)=2$. Thus $r_H(u) = 6 - d_H(u)$. Thus there are three types of Revan edges based on the degree of the end revan vertices of each revan edge as follows:

$RE_{44} = \{uv \in E(H)| r_H(u) = r_H(v) = 4\}, \ |RE_{44}| = 2.$

$RE_{42} = \{uv \in E(H)| r_H(u) = 4, d_H(v) = 2\}, \ |RE_{42}| = 8n - 4.$

$RE_{22} = \{uv \in E(H)| r_H(u) = r_H(v) = 2\}, \ |RE_{22}| = 6n^2 - 8n + 2.$

(1) To compute $R_1(RHOX_n)$, we see that

$$R_1(H)=\sum_{uv\in E(H)}\left[r_H(u)+r_H(v)\right]=\sum_{RE_{44}}\left[r_H(u)+r_H(v)\right]+\sum_{RE_{42}}\left[r_H(u)+r_H(v)\right]+\sum_{RE_{22}}\left[r_H(u)+r_H(v)\right]$$

$$=8\times 2+6(8n-4)+4\left(6n^2-8n+2\right)=24n^2+16n.$$

(2) To compute $R_2(RHOX_n)$, we see that

$$R_2(H)=\sum_{uv\in E(H)}r_H(u)r_H(v)=\sum_{RE_{44}}r_H(u)r_H(v)+\sum_{RE_{42}}r_H(u)r_H(v)+\sum_{RE_{22}}r_H(u)r_H(v)$$

$$=16\times 2+8(8n-4)+4\left(6n^2-8n+2\right)=24n^2+32n+8.$$

(3) To compute $R_3(RHOX_n)$, we see that

$$R_3(H)=\sum\left|r_H(u)-r_H(v)\right|=\sum\left|r_H(u)-r_H(v)\right|+\sum\left|r_H(u)-r_H(v)\right|+\sum\left|r_H(u)-r_H(v)\right|$$
$$=0\times 2+2(8n-4)+0\left(6n^2-8n+2\right)=16n-8.$$

In the following theorem, we compute the value of $R_1(RHOX_n, x)$, $R_2(RHOX_n, x)$, $R_3(RHOX_n, x)$ for rhombus oxide networks.
Theorem 6. Let $RHOX_n$ be the rhombus oxide network. Then

$$R_1\left(RHOX_n,x\right)=2x^8+(8n-4)x^6+\left(6n^2-8n+2\right)x^4. \quad (1)$$
$$R_2\left(RHOX_n,x\right)=2x^{16}+(8n-4)x^8+\left(6n^2-8n+2\right)x^4. \quad (2)$$
$$R_3\left(RHOX_n,x\right)=(8n-4)x^2+6n^2-8n+4. \quad (3)$$

Proof : (1) Using the partition of the revan edge set, we can apply the formula of the first Revan polynomial of H.

Since $R_1(H,x)=\sum_{uv\in E(H)}x^{r_H(u)+r_H(v)}$,

this implies that

$$R_1\left(RHOX_n,x\right)=2x^8+(8n-4)x^6+\left(6n^2-8n+2\right)x^4.$$

(2) Using the partition of the revan edge set, we can apply the formula of the second Revan polynomial of *H*.

Since $R_2(H,x)=\sum_{uv\in E(H)}x^{r_H(u)r_H(v)}$,

this implies that

$$R_2\left(RHOX_n,x\right)=2x^{16}+(8n-4)x^8+\left(6n^2-8n+2\right)x^4.$$

(3) Using the partition of reven edge set, we can apply the formula of the third Revan polynomial of *H*.

Since $R_3(H,x)=\sum_{uv\in E(H)}x^{\left|r_H(u)-r_H(v)\right|}$,

this implies that

$$R_3\left(RHOX_n,x\right)=2x^0+(8n-4)x^2+\left(6n^2-8n+2\right)x^0.$$
$$=(8n-4)x^2+6n^2-8n+4.$$

REFERENCES

V.R. Kulli, 2012. *College Graph Theory*, Vishwa International Publications, Gulbarga, India.
R. Todeschini and V. Consonni, *Molecular Descriptors for Chemoinformatics*, Wiley-VCH, Weinheim, (2009).

V.R. Kulli, Revan indices of oxide and honeycomb networks, *International Journal of Mathematics and its Applications*, 5(4-E) (2017) 663-667.
V.R. Kulli, The sum connectivity Revan index of silicate and hexagonal networks, *Annals of Pure and Applied Mathematics*, 14(3) (2017) 401-406. DOI: http://dx.doi.org/10.22457/apam.v14n3a6.
V.R. Kulli, On the product connectivity Revan index of certain nanotubes, *Journal of Computer and Mathematical Sciences*, 8(10)(2017) 562-567.
V.R. Kulli, Hyper-Revan indices and their polynomials of silicate networks, *International Journal of Current Research in Science and Technology,*to appear.
V.R. Kulli, On *K* edge index of some nanostructures, *Journal of Computer and Mathematical Sciences*, 7(7), (2016) 373-378.
V.R.Kulli, On the sum connectivity Gourava index, *International Journal of Mathematical Archive*, 8(7)(2017) 211-217.
V.R.Kulli, Two new multiplicative atom bond connectivity indices, *Annals of Pure and Applied Mathematics*, 13(1) (2017) 1-7. DOI:http://dx.doi.org/10.22457/apam.vl3nlal.
V.R.Kulli, New K Banhatti topological indices, *International Journal of Fuzzy Mathematical Archive*, 12(1) (2017) 29-37. DOI:http://dx.doi.org/10.22457/ijfma. v12n1a4.
V.R.Kulli, The Gourava indices and coindices of graphs, *Annals of Pure and Applied Mathematics*, 14(1) (2017) 33-38. DOI:http://dx.doi-org/10.22457/apam.v14n1a4.
V.R. Kulli, On the sum connectivity reverse index of oxide and honeycomb networks, *Journal of Computer and Mathematical Sciences,* 8(9) (2017) 408-413.
V.R. Kulli, On the product connectivity reverse index of silicate and hexagonal networks, *International Journal of Mathematics and its Applications,* 5(4-B) (2017) 175-179.
V.R. Kulli, Geometric-arithmetic reverse and sum connectivity reverse indices of silicate and hexagonal networks, *International Journal of Current Research in Science and Technology,* 3(10) (2017) 29-33.
V.R.Kulli, Edge version of *F*-index, general sum connectivity index of certain nanotubes, *Annals of Pure and Applied Mathematics*, 14(3) (2017) 449-455. DOI:http://dx.doi.org/10.22457/apam. v14n3a11.
V.R. Kulli, General Zagreb polynomials and *F*-polynomial of certain nanostructures, *International Journal of Mathematical Archive,* 8(10) (2017) 103-109.
V.R.Kulli, General fifth *M*-Zagreb indices and fifth *M*-Zagreb polynomials of PAMAM dendrimers, *International Journal of Fuzzy Mathematical Archive*, 13(1) (2017) 99-103. DOI:http://dx.doi.org/10.22457/ijfma.v13n1a10.
V.R.Kulli, Certain topological indices and their polynomials of dendrimer nanostars, *Annals of Pure and Applied Mathematics*, 14(2) (2017) 263-268. DOI:http://dx.doi.org/10.22457/apam.v14n2a9.
V.R. Kulli, Some Gourava indices and inverse sum indeg index of certain networks, *International Research Journal of Pure Algebra,* 7(7) (2017) 787-798.

****