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Revan Indices and Revan Polynomials of Silicon Carbide Graphs

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***Abstract*— Topological polynomials are algebraic expressions which are related to the topology of graphs up to graph isomorphism. They are used to indicate the invariants of graphs of chemical structures. In a chemical graph, vertices and edges correspond to atoms and bonds respectively. The quantitative structure property relationship (QSPR) depicts a connection between the structure and the properties of molecules. There are numerous types of topological indices among them degree based are more popular. In this paper we compute Revan first index, Revan second index, Revan third index and their polynomials for list of silicon carbide graphs. Comparison between Revan first index, Revan second index and Revan third index is also part of our study.**

Keywords*— Chemical graph theory; chemical graph; atoms; bonds; silicon carbide; Revan vertex degree; first Revan index; second Revan index, third Revan index, Revan polynomials.

I. INTRODUCTION

Chemical graph theory is a topology branch of mathematical chemistry which deals with applications of graph theory to mathematical structure of chemical phenomena. Molecular graphs are the basic models of chemical graph theory in which vertices corresponds to vertices and edges correspond to bonds. The quantitative structure property relationship (QSPR) depicts a connection between the structure and the properties of molecules [1], [2]. Various numerical graph invariants and their related polynomials have been defined and used for correlation analysis in theoretical chemistry, pharmacology, toxicology and environmental chemistry. A topological index is a type of molecular descriptor which is calculated for a molecular graph of chemical phenomena. Topological indices are used to study the topology and graph invariants of molecular graphs. For a simple, connected and undirected graph $G = (V(G), E(G))$ with vertex set $V(G)$ and edge set $E(G)$, uv is an edge with end vertices u and v, d_u denotes the ordinary degree of vertex u in G, $\Delta(G)$ denotes the maximum degree of G and $\delta(G)$ is the minimum degree of G. For a simple and connected graph G, V. R. Kulli [5] introduced Revan first index, Revan second index and third Revan index as:

$$R_1(G) = \sum_{uv\in E(G)} (r_u + r_v)$$

$$R_2(G) = \sum_{uv\in E(G)} (r_u \cdot r_v)$$

$$R_3(G) = \sum_{uv\in E(G)} |r_u - r_v|$$

Where r_v is *Revan degree* of a vertex v defined by Kulli as $r_v = \Delta(G) + \delta(G) - d_v$.

In 2018, V. R. Kulli [6] introduced first, second and third Revan polynomials of a simple connected graph G as:

$$R_1(G,x) = \sum_{uv\in E(G)} x^{(r_u+r_v)}$$

$$R_2(G,x) = \sum_{uv\in E(G)} x^{(r_u\cdot r_v)}$$

$$R_3(G,x) = \sum_{uv\in E(G)} x^{|r_u-r_v|}$$

II. SILICON CARBIDE GRAPHS

We consider a family of silicon carbide graphs, and calculate necessary computations in this section. This family includes eight silicon carbide graphs with the names and notation as: $Si_2C_3 - I[n,m], Si_2C_3 - II[n,m], Si_2C_3 - III[n,m], SiC_3 - I[n,m]$, $SiC_3 - II[n,m], SiC_3 - III[n,m]$, $SiC_4 - I[n,m]$, and $SiC_4 - II[n,m]$ for arbitrary $n, m \geq 1$. Here we list some graph terms and properties which is a common possession of all these eight graphs:

i. In all graphs of silicon carbides, silicon atoms Si are colored blue and carbon atoms C are colored red, green color edges are used to connect two cells in a colums and red color edges are used to connect two cells in a row.

ii. In all graphs, vertices have ordinary degree $1, 2$ or 3 and since $\Delta(G) + \delta(G) = 4$, so vertices have Revan degree $3, 2$ or 1 respectively.

iii. An edge uv has a *type* $\{r_u, r_v\}$ if vertex u has Revan degree r_u and vertex v has Revan degree r_v.

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iv.Edge sets of all eight silicon carbide graphs are portioned with respect to type defined above and cardinalities of partite sets are computed.

Description and computations about these graphs are as follows:

1. The $2D$ structure of silicon carbide graph $G \cong Si_2C_3 - I[n,\ m], n, m \geq 1,$ is shown in Figure 1.
2.

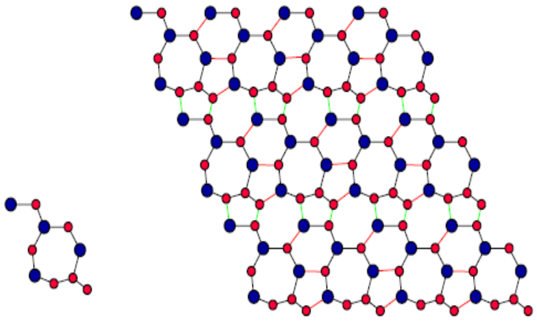

Figure 1

This structure consists of n cells (in a row) and m connected rows. Left figure is a unit cell and right figure is of $Si_2C_3 - I[4,\ 3]$. Order of this graph is $10nm$ and size is $15nm - 2n - 3m$. Edge partition and cardinalities of partite sets are given as:

$RE_{3,2} = \{uv \in E(Si_2C_3 - I[n, m]) | r_u = 3, r_v = 2\},$
$RE_{3,1} = \{uv \in E(Si_2C_3 - I[n, m]) | r_u = 3, r_v = 1\},$
$RE_{2,2} = \{uv \in E(Si_2C_3 - I[n, m]) | r_u = 2, r_v = 2\},$
$RE_{2,1} = \{uv \in E(Si_2C_3 - I[n, m]) | r_u = 2, r_v = 1\},$
$RE_{1,1} = \{uv \in E(Si_2C_3 - I[n, m]) | r_u = 1, r_v = 1\},$

And cardinalities are $|RE_{3,2}| = 1$, $|RE_{3,1}| = 1$, $|RE_{2,2}| = n + 2m$, $|RE_{2,1}| = 6n + 8m - 9$, $|RE_{1,1}| = 15mn - 9n - 13m + 7$.

3. The $2D$ structure of $Si_2C_3 - II[n,\ m], n, m \geq 1,$ is shown in Figure 2.

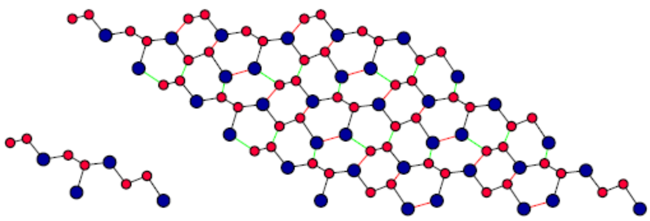

Figure 2

This structure consists of n cells (in a row) and m connected rows. Order of this graph is $10nm$ and size is $15nm - 3n - 3m$. Left picture is a unit cell and right is of $Si_2C_3 - II[3,\ 3]$. Edge set is partitioned into following sets:

$RE_{3,2} = \{uv \in E(Si_2C_3 - II[n, m]) | r_u = 3, r_v = 2\},$
$RE_{3,1} = \{uv \in E(Si_2C_3 - II[n, m]) | r_u = 3, r_v = 1\},$
$RE_{2,2} = \{uv \in E(Si_2C_3 - II[n, m]) | r_u = 2, r_v = 2\},$
$RE_{2,1} = \{uv \in E(Si_2C_3 - II[n, m]) | r_u = 2, r_v = 1\},$
$RE_{1,1} = \{uv \in E(Si_2C_3 - II[n, m]) | r_u = 1, r_v = 1\},$

and cardinalities of partite sets are: $|RE_{3,2}| = 2$, $|RE_{3,1}| = 1$, $|RE_{2,2}| = 2n + 2m$, $|RE_{2,1}| = 8n + 8m - 14$, $|RE_{1,1}| = 15mn - 13n - 13m + 11$

4. The $2D$ structure of $G \cong Si_2C_3 - III[n,\ m]$, $n, m \geq 1,$ is shown in Figure 3. Left picture is a unit cell and right is of $Si_2C_3 - III[4,\ 3]$ This structure consists of n cells (in a row) and m connected rows. Order of this graph G is $10nm$ and size is $15nm - 2n - 3m$.

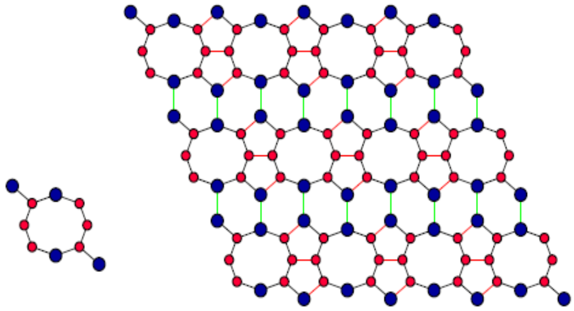

Figure 3

Edge set is partitioned into following sets:

$RE_{3,1} = \{uv \in E(Si_2C_3 - III[n, m]) | r_u = 3, r_v = 1\},$
$RE_{2,2} = \{uv \in E(Si_2C_3 - III[n, m]) | r_u = 2, r_v = 2\},$
$RE_{2,1} = \{uv \in E(Si_2C_3 - III[n, m]) | r_u = 2, r_v = 1\},$
$RE_{1,1} = \{uv \in E(Si_2C_3 - III[n, m]) | r_u = 1, r_v = 1\},$

And cardinalities of partite sets are $|RE_{3,1}| = 1$, $|RE_{2,2}| = 2 + 2m$, $|RE_{2,1}| = 8n + 8m - 12$, $|RE_{1,1}| = 15mn - 10n - 13m + 8$

4. The $2D$ structure of $G \cong SiC_3 - I[n,\ m]$, $n, m \geq 1$, is shown in Figure 4. This structure consists of n cells (in a row) and m connected rows.

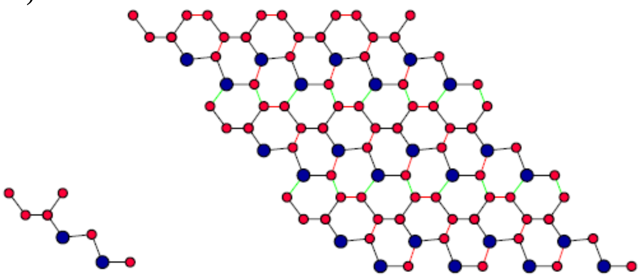

Figure 4

Left picture is a unit cell and right is of $SiC_3 - I[4,\ 3]$. Order of this graph G is $8nm$ and size is $12nm - 2n - 3m$. Edge set is partitioned inteo following sets:

$RE_{3,2} = \{uv \in E(SiC_3 - I[n, m]) | r_u = 3, r_v = 2\}$
$RE_{3,1} = \{uv \in E(SiC_3 - I[n,\ m]) | r_u = 3, r_v = 1\}, = 1$
$RE_{2,2} = \{uv \in E(SiC_3 - I[n,\ m]) | r_u = 2, r_v = 2\},$
$RE_{2,1} = \{uv \in E(SiC_3 - I[n,\ m]) | r_u = 2, r_v = 1\},$
$RE_{1,1} = \{uv \in E(SiC_3 - I[n,\ m]) | r_u = 1, r_v = 1\},$

And cardinalities are $|RE_{3,2}| = 2$, $|RE_{3,1}|$

$$|RE_{2,2}| = \begin{cases} 3m - 1 \text{ for } n = 1, m \geq 1 \\ 2n + 2m - 3 \text{ for } n > 1, m \geq 1 \end{cases}$$

$$|RE_{2,1}| = \begin{cases} 6m-4 \text{ for } n=1, m\geq 1 \\ 4n+8m-8 \text{ for } n>1, m\geq 1 \end{cases}$$
$$|RE_{1,1}| = \begin{cases} 12mn-2n-12m+2 \text{ for } n=1, m\geq 1 \\ 12mn-8n-13m+8 \text{ for } n>1, m\geq 1 \end{cases}$$

5. The $2D$ structure of $SiC_3-II[n,\ m],\ n,m\geq 1,$ is shown in Figure 5. This structure consists of n cells (in a row) and m connected rows. Order of this graph is $8nm$ and size is $12nm-2n-2m$. Left picture is a unit cell and right is of $SiC_3-II[4,\ 3]$.

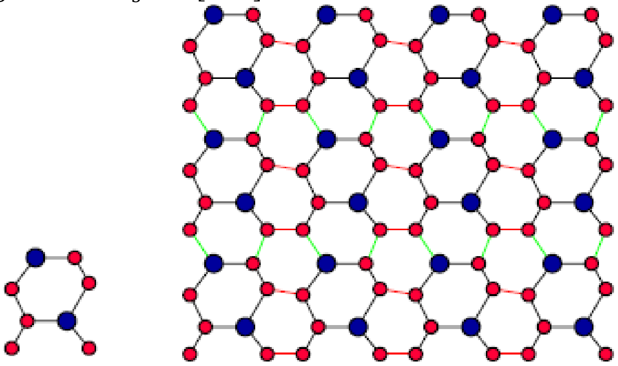

Figure 5

Edge set is partitioned into following sets
$RE_{3,1}=\{uv\in E(SiC_3-I[n,\ m])|r_u=3, r_v=1\}$,
$RE_{2,2}=\{uv\in E(SiC_3-I[n,\ m])|r_u=2, r_v=2\}$
$RE_{2,1}=\{uv\in E(SiC_3-I[n,\ m])|r_u=2, r_v=1\}$,
$RE_{1,1}=\{uv\in E(SiC_3-I[n,\ m])|r_u=1, r_v=1\}$,
And cardinalities of partite sets are computed as $|RE_{3,1}|=2$, $|RE_{2,2}|=2n+1$, $|RE_{2,1}|=4n+8m-10$, $|RE_{1,1}|=12nm-8n-10m+7$.

6. The $2D$ structure of $G\cong SiC_3-III[n,\ m],\ n,m\geq 1,$ is shown in Figure 6.

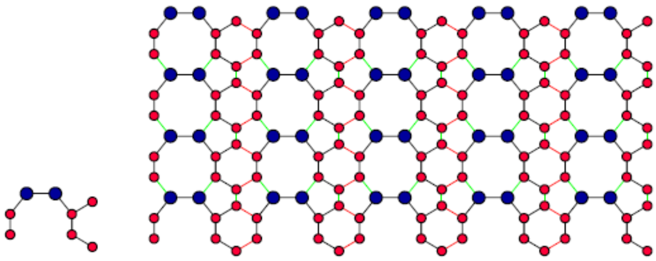

Figure 6

This structure consists of n cells (in a row) and m connected rows. Order of this graph is $8nm$ and size is $12nm-3n-2m$. Left picture is a unit cell and right is of $SiC_3-III[5,\ 4]$.
Edge set is partitioned into following sets:
$RE_{3,2}=\{uv\in E(SiC_3-III[n,\ m])|r_u=3, r_v=2\}$,
$RE_{3,1}=\{uv\in E(SiC_3-III[n,\ m])|r_u=3, r_v=1\}$,
$RE_{2,2}=\{uv\in E(SiC_3-III[n,\ m])|r_u=2, r_v=2\}$,
$RE_{2,1}=\{uv\in E(SiC_3-III[n,\ m])|r_u=2, r_v=1\}$,
$RE_{1,1}=\{uv\in E(SiC_3-III[n,\ m])|r_u=1, r_v=1\}$,

And cardinalities of partite sets are $|RE_{3,2}|=2$, $|RE_{3,1}|=1$, $|RE_{2,2}|=3n+2m-3$, $|RE_{2,1}|=6n+4m-8$, $|RE_{1,1}|=12mn-12n-8m+8$.

7. The $2D$ structure of $G\cong SiC_4-I[n,\ m], n,m\geq 1,$ is shown in Figure 7. This structure consists of n cells (in a row) and m connected rows. Order of this graph G is $10nm$ and size is $15nm-4n-2m+1$. Left picture is a unit cell and right is of $SiC_4-I[4,\ 3]$.
Partition of edge set is
$RE_{3,2}=\{uv\in E(SiC_4-I[n,\ m])|r_u=3, r_v=2\}$,
$RE_{3,1}=\{uv\in E(SiC_4-I[n,\ m])|r_u=3, r_v=1\}$,

$RE_{2,2}=\{uv\in E(SiC_4-I[n,\ m])|r_u=2, r_v=2\}$,
$RE_{2,1}=\{uv\in E(SiC_4-I[n,\ m])|r_u=2, r_v=1\}$,
$RE_{1,1}=\{uv\in E(SiC_4-I[n,\ m])|r_u=1, r_v=1\}$,
And cardinalities of partite sets are $|RE_{3,2}|=2$, $|RE_{3,1}|=3n-2$, $|RE_{2,2}|=n+2m-2$, $|RE_{2,1}|=2n+4m-2$, $|RE_{1,1}|=14mn-10n-8m+5$

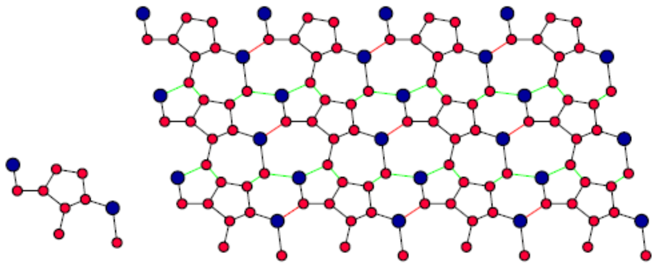

Figure 7

8. The $2D$ structure of $SiC_4-II[n,\ m], n,m\geq 1,$ is shown in Figure 8.

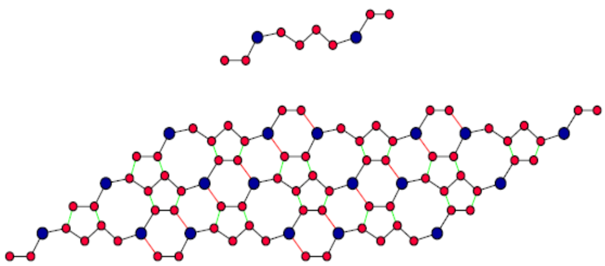

Figure 8

This structure consists of n cells (in a row) and m connected rows. Order of this graph is $10nm$ and size is $15nm-4n-2m$. First picture is a unit cell and second is of $SiC_4-II[3,\ 3]$. Edge set is partitioned into following sets:
$RE_{3,2}=\{uv\in E(SiC_4-II[n,\ m])|r_u=3, r_v=2\}$,
$RE_{2,2}=\{uv\in E(SiC_4-II[n,\ m])|r_u=2, r_v=2\}$,
$RE_{2,1}=\{uv\in E(SiC_4-II[n,\ m])|r_u=2, r_v=1\}$,
$RE_{1,1}=\{uv\in E(SiC_4-II[n,\ m])|r_u=1, r_v=1\}$,
And cardinalities of partite sets are $|RE_{3,2}|=2$

$$|RE_{2,2}| = \begin{cases} 5n+2 \text{ for } m=1, n\geq 1 \\ 2n+2 \text{ for } m>1, n\geq 1 \end{cases}$$

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$$|RE_{2,1}| = \begin{cases} 6n-6 & \text{for } m=1, n\geq 1 \\ 12n+8m-14 & \text{for } m>1, n\geq 1 \end{cases}$$

$$|RE_{1,1}| = \begin{cases} 15nm-15n-2m+2 & \text{for } m=1, n\geq 1 \\ 15nm-18n-10m+10 & \text{for } m>1, n\geq 1 \end{cases}$$

III. MAIN RESULTS

In this section, we prove results about family of silicon carbide graphs listed in previous section. Here we present results of Revan indices and Revan polynomials for our list of silicon carbide graphs.

Theorem 3.1. Let $G \cong Si_2C_3 - I[n,m], n,m \geq 1$ be the silicon carbide graph, then

1. $R_1(G) = 30mn + 4n + 6m - 4.$
2. $R_2(G) = 15mn + 7n + 11m - 2.$
3. $R_3(G) = 6n + 8m - 6.$

Proof. Adding entries of last column, we get $R_1(G)$.

$\{r_u, r_v\}$	$f = \lvert RE_{u,v}\rvert$	$r_u + r_v$	$f\cdot(r_u+r_v)$
$\{3,2\}$	1	5	5
$\{3,1\}$	1	4	4
$\{2,2\}$	$n+2m$	4	$4n+8m$
$\{2,1\}$	$6n+8m-9$	3	$18n+24m-27$
$\{1,1\}$	$15mn-9n-13m+7$	2	$30mn-18n-26m+14$

Revan first polynomial is

$$R_1(G,x) = \sum_{uv\in E(G)} x^{(r_u+r_v)} = x^5 + (n+2m+1)x^4$$
$$+(6n+8m-9)x^3+(15mn-9n-13m+7)x^2.$$

Adding entries of last column, we get $R_2(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v}\rvert$	$r_u \cdot r_v$	$f\cdot(r_u\cdot r_v)$
$\{3,2\}$	1	6	6
$\{3,1\}$	1	3	3
$\{2,2\}$	$n+2m$	4	$4n+8m$
$\{2,1\}$	$6n+8m-9$	2	$12n+16m-18$
$\{1,1\}$	$15mn-9n-13m+7$	1	$15mn-9n-13m+7$

Revan second polynomial is

$$R_2(G,x) = \sum_{uv\in E(G)} x^{(r_u\cdot r_v)} = x^6 + (n+2m)x^4 + x^3 + (6n+8m-9)x^2 + (15mn-9n-13m+7)x$$

Adding entries of last column, we get $R_3(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v}\rvert$	$\lvert r_u - r_v\rvert$	$f\cdot\lvert r_u-r_v\rvert$
$\{3,2\}$	1	1	1
$\{3,1\}$	1	2	2
$\{2,2\}$	$n+2m$	0	0
$\{2,1\}$	$6n+8m-9$	1	$6n+8m-9$
$\{1,1\}$	$15mn-9n-13m+7$	0	0

Revan third polynomial is

$$R_3(G,x) = \sum_{uv\in E(G)} x^{\lvert r_u-r_v\rvert} = x^2 + (6n+8m-8)x + (15mn-8n-11m+7)$$

Theorem 3.2. Let $G \cong Si_2C_3 - II[n,m], n,m \geq 1$ be the silicon carbide graph, then

1. $R_1(G) = 30mn + 6n + 6m - 6.$
2. $R_2(G) = 15mn + 11n + 11m - 2.$
3. $R_3(G) = 8n + 8m - 10.$

Proof. Adding entries of last column, we get $R_1(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v}\rvert$	$r_u + r_v$	$f\cdot(r_u+r_v)$
$\{3,2\}$	2	5	10
$\{3,1\}$	1	4	4
$\{2,2\}$	$2n+2m$	4	$8n+8m$
$\{2,1\}$	$8n+8m-14$	3	$24n+24m-42$
$\{1,1\}$	$15mn-13n-13m+11$	2	$30mn-26n-26m+22$

Revan first polynomial is

$$R_1(G,x) = \sum_{uv\in E(G)} x^{(r_u+r_v)} = 2x^5 + (2n+2m+1)x^4$$
$$+(8n+8m-14)x^3+(15mn-13n-13m+11)x^2.$$

Adding entries of last column, we get $R_2(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v}\rvert$	$r_u \cdot r_v$	$f\cdot(r_u\cdot r_v)$
$\{3,2\}$	2	6	12
$\{3,1\}$	1	3	3
$\{2,2\}$	$2n+2m$	4	$8n+8m$
$\{2,1\}$	$8n+8m-14$	2	$16n+16m-28$
$\{1,1\}$	$15mn-13n-13m+11$	1	$15mn-13n-13m+11$

Revan second polynomial is $R_2(G,x) = \sum_{uv\in E(G)} x^{(r_u\cdot r_v)} = 2x^6 + (2n+2m)x^4 + x^3 +$

$$(8n+8m-14)x^2 + (15mn-13n-13m+11)x$$

Adding entries of last column, we get $R_3(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v}\rvert$	$\lvert r_u - r_v\rvert$	$f\cdot\lvert r_u-r_v\rvert$
$\{3,2\}$	2	1	2
$\{3,1\}$	1	2	2
$\{2,2\}$	$2n+2m$	0	0
$\{2,1\}$	$8n+8m-14$	1	$8n+8m-14$
$\{1,1\}$	$15mn-13n-13m+11$	0	0

Revan third polynomial is $R_3(G,x) = \sum_{uv\in E(G)} x^{\lvert r_u-r_v\rvert} = x^2 + (8n+8m-12)x + (15mn-11n-11m+11).$

Theorem 3.3. Let $G \cong Si_2C_3 - III[n,m], n,m \geq 1$ be the silicon carbide graph, then

1. $R_1(G) = 30mn + 4n + 6m - 4.$
2. $R_2(G) = 15mn + 6n + 11m - 2.$
3. $R_3(G) = 8n + 8m - 8.$

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Proof. Adding entries of last column, we get $R_1(G)$.

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u + r_v$	$f \cdot (r_u + r_v)$
$\{3,1\}$	2	4	8
$\{2,2\}$	$2m + 2$	4	$8m + 8$
$\{2,1\}$	$8n + 8m - 12$	3	$24n + 24m - 36$
$\{1,1\}$	$15mn - 10n - 13m + 8$	2	$30mn - 20n - 26m + 16$

Revan first polynomial is

$R_1(G, x) = \sum_{uv \in E(G)} x^{(r_u + r_v)} = (2m + 4)x^4 + (8n + 8m - 12)x^3 + (15mn - 10n - 13m + 8)x^2$.

Adding entries of last column, we get $R_2(G)$

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
$\{3,1\}$	2	3	6
$\{2,2\}$	$2m + 2$	4	$8m + 8$
$\{2,1\}$	$8n + 8m - 12$	2	$16n + 16m - 24$
$\{1,1\}$	$15mn - 10n - 13m + 8$	1	$15mn - 10n - 13m + 8$

Revan second polynomial is

$R_2(G, x) = \sum_{uv \in E(G)} x^{(r_u \cdot r_v)} = (2m + 4)x^4 + 2x^3 + (8n + 8m - 12)x^2 + (15mn - 10n - 13m + 8)x$

Adding entries of last column, we get $R_3(G)$

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$\|r_u - r_v\|$	$f \cdot \|r_u - r_v\|$
$\{3,1\}$	2	2	4
$\{2,2\}$	$2m + 2$	0	0
$\{2,1\}$	$8n + 8m - 12$	1	$8n + 8m - 12$
$\{1,1\}$	$15mn - 10n - 13m + 8$	0	0

Revan third polynomial is $R_3(G, x) = \sum_{uv \in E(G)} x^{|r_u - r_v|} = 2x^2 + (8n + 8m - 12)x + (15mn - 10n - 11m + 10)$.

Theorem 3.4. Let $SiC_3 - I[n, m], n, m \geq 1$ be the silicon carbide graph, then

1. $R_1(G) = \begin{cases} 24mn - 4n + 6m + 2 \text{ for } n = 1, m \geq 1 \\ 24mn + 4n + 6m - 8 \text{ for } n > 1, m \geq 1 \end{cases}$
2. $R_2(G) = \begin{cases} 12mn - 2n + 12m + 5 \text{ for } n = 1, m \geq 1 \\ 12mn + 8n + 11m - 8 \text{ for } n > 1, m \geq 1 \end{cases}$
3. $R_3(G) = \begin{cases} 6m & \text{for } n = 1, m \geq 1 \\ 4n + 8m - 4 & \text{for } n > 1, m \geq 1 \end{cases}$

Proof. Adding entries of last column, we get $R_1(G)$ for for $n = 1, m \geq 1$.

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u + r_v$	$f \cdot (r_u + r_v)$
$\{3,2\}$	2	5	10
$\{3,1\}$	1	4	4
$\{2,2\}$	$3m - 1$	4	$12m - 4$
$\{2,1\}$	$6m - 4$	3	$18m - 12$
$\{1,1\}$	$12mn - 2n - 12m + 2$	2	$24mn - 4n - 24m + 4$

Adding entries of last column, we get $R_1(G)$ for $n > 1$, $m \geq 1$.

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u + r_v$	$f \cdot (r_u + r_v)$
$\{3,2\}$	2	5	10
$\{3,1\}$	1	4	4
$\{2,2\}$	$2n + 2m - 3$	4	$8n + 8m - 12$
$\{2,1\}$	$4n + 8m - 8$	3	$12n + 24m - 24$
$\{1,1\}$	$12mn - 8n - 13m + 8$	2	$24mn - 16n - 26m + 16$

Revan first polynomial is $R_1(G, x)$ for $n = 1, m \geq 1$

$\sum_{uv \in E(G)} x^{(r_u + r_v)} = 2x^5 + 3mx^4 + (6m - 4)x^3 + (12mn - 2n - 12m + 2)x^2$.

And Revan first polynomial for $n > 1, m \geq 1$

$R_1(G, x) = 2x^5 + (2n + 2m - 2)x^4 + (4n + 8m - 8)x^3 + (12mn - 8n - 13m + 8)x^2$.

Adding entries of last column, we get

$R_2(G)$ for $n = 1, m \geq 1$

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
$\{3,2\}$	2	6	12
$\{3,1\}$	1	3	3
$\{2,2\}$	$3m - 1$	4	$12m - 4$
$\{2,1\}$	$6m - 4$	2	$12m - 8$
$\{1,1\}$	$12mn - 2n - 12m + 2$	1	$12mn - 2n - 12m + 2$

Adding entries of last column, we get $R_2(G)$ for $n > 1$, $m \geq 1$.

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
$\{3,2\}$	2	6	12
$\{3,1\}$	1	3	3
$\{2,2\}$	$2n + 2m - 3$	4	$8n + 8m - 12$
$\{2,1\}$	$4n + 8m - 8$	2	$8n + 8m - 16$
$\{1,1\}$	$12mn - 8n - 13m + 8$	1	$12mn - 8n - 13m + 8$

Revan second polynomial $R_2(G, x)$ for $n = 1, m \geq 1$

$\sum_{uv \in E(G)} x^{(r_u \cdot r_v)} = 2x^6 + (3m - 1)x^4 + x^3 + +(6m - 4)x^2 + (12mn - 2n - 12m + 2)x$.

And Revan second polynomial for $n > 1, m \geq 1$ is

$R_2(G, x) = 2x^6 + (2n + 2m - 3)x^4 + x^3 + +(4n + 8m - 8)x^2 + (12mn - 8n - 13m + 8)x$.

Adding entries of last column, we get

$R_3(G)$ for $n = 1, m \geq 1$.

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$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$\lvert r_u - r_v \rvert$	$f \cdot \lvert r_u - r_v \rvert$
{3,2}	2	1	2
{3,1}	1	2	2
{2,2}	$3m-1$	0	0
{2,1}	$6m-4$	1	$6m-4$
{1,1}	$12mn-2n-12m+2$	0	0

Adding entries of last column, we get $R_3(G)$ for $n > 1$, $m \geq 1$.

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$\lvert r_u - r_v \rvert$	$f \cdot \lvert r_u - r_v \rvert$
{3,2}	2	1	2
{3,1}	1	2	2
{2,2}	$2n+2m-3$	0	0
{2,1}	$4n+8m-8$	1	$4n+8m-8$
{1,1}	$12mn-8n-13m+8$	0	0

Revan third polynomial is $R_3(G,x)$ for $n = 1, m \geq 1$ $= \sum_{uv\in E(G)} x^{|r_u - r_v|} = x^2 + (6m-2)x + (12mn - 2n - 9m + 1)$.
And Revan third polynomial for $n > 1, m \geq 1$
$R_3(G,x) = x^2 + (4n + 8m - 6)x + (12mn - 6n - 11m + 5)$.

Theorem 3.5. Let $SiC_3 - II[n,m], n,m \geq 1$ be the silicon carbide graph, then
1. $R_1(G) = 24mn + 4n + 4m - 8$.
2. $R_2(G) = 12mn + 8n + 6m - 6$.
3. $R_3(G) = 4n + 8m - 6$.

Proof. Adding entries of last column, we get $R_1(G)$.

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$r_u + r_v$	$f \cdot (r_u + r_v)$
{3,1}	1	4	4
{2,2}	$2n+1$	4	$8n+4$
{2,1}	$4n+8m-10$	3	$12n+24m-30$
{1,1}	$12mn-8n-10m+7$	2	$24mn-8n-10m+7$

Revan first polynomial is $R_1(G,x) = \sum_{uv\in E(G)} x^{(r_u + r_v)} = (2n+1)x^4 + (4n+8m-10)x^3 + (12mn - 8n - 10m + 7)x^2$.

Adding entries of last column, we get $R_2(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
{3,1}	1	3	3
{2,2}	$2n+1$	4	$8n+4$
{2,1}	$4n+8m-10$	2	$8n+16m-20$
{1,1}	$12mn-8n-10m+7$	1	$12mn-8n-10m+7$

Revan second polynomial is $R_2(G,x) = \sum_{uv\in E(G)} x^{(r_u \cdot r_v)} = (2n+1)x^4 + x^3 + (4n+8m-10)x^2 + (12mn - 8n - 10m + 7)x$

Adding entries of last column, we get $R_3(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$\lvert r_u - r_v \rvert$	$f \cdot \lvert r_u - r_v \rvert$
{3,1}	2	2	4
{2,2}	$2n+1$	0	0
{2,1}	$4n+8m-10$	1	$4n+8m-10$
{1,1}	$12mn-8n-10m+7$	0	0

Revan third polynomial is $R_3(G,x) = \sum_{uv\in E(G)} x^{|r_u - r_v|} = 2x^2 + 4n + 8m - 10x + (12mn - 6n - 10m + 8)$.

Theorem 3.6. Let $SiC_3 - III[n,m], n,m \geq 1$ be the silicon carbide graph, then
1. $R_1(G) = 24mn + 6n + 4m - 6$.
2. $R_2(G) = 12mn + 12n + 8m - 5$.
3. $R_3(G) = 6n + 4m - 4$.

Proof. Adding entries of last column, we get $R_1(G)$.

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$r_u + r_v$	$f \cdot (r_u + r_v)$
{3,2}	2	5	10
{3,1}	1	4	4
{2,2}	$3n+2m-3$	4	$12n+8m-12$
{2,1}	$6n+4m-8$	3	$18n+12m-24$
{1,1}	$12mn-12n-8m+8$	2	$24mn-24n-16m+16$

Revan first polynomial is $R_1(G,x) = \sum_{uv\in E(G)} x^{(r_u + r_v)} = 2x^5 + (3n + 2m - 3)x^4$

$+(6n + 4m - 8)x^3 + (12mn - 12n - 8m + 8)x^2$.

Adding entries of last column, we get $R_2(G)$

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
{3,2}	2	6	12
{3,1}	1	3	3
{2,2}	$3n+2m-3$	4	$12n+8m-12$
{2,1}	$6n+4m-8$	2	$12n+8m-16$
{1,1}	$12mn-12n-8m+8$	1	$12mn-12n-8m+8$

Revan second polynomial is $R_2(G,x) = \sum_{uv\in E(G)} x^{(r_u \cdot r_v)} = 2x^6 + (3n + 2m - 3)x^4 + x^3 + +(6n + 4m - 8)x^2 + (12mn - 12n - 8m + 8)x$

Adding entries of last column, we get $R_3(G)$

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$\|r_u - r_v\|$	$f \cdot \|r_u - r_v\|$
{3,2}	2	1	2
{3,1}	1	2	2
{2,2}	$3n + 2m - 3$	0	0
{2,1}	$6n + 4m - 8$	1	$6n + 4m - 8$
{1,1}	$12mn - 12n - 8m + 8$	0	0

Revan third polynomial is $R_3(G,x) = \sum_{uv\in E(G)} x^{|r_u - r_v|} = x^2 + (6n + 4m - 6)x + (12mn - 9n - 6m + 5)$.

Theorem 3.7. Let $SiC_4 - I[n,m], n,m \geq 1$ be the silicon carbide graph, then

1. $R_1(G) = 30mn + 2n + 4m - 2$.
2. $R_2(G) = 15mn + 7n + 8m - 1$.
3. $R_3(G) = 8n + 4m - 4$.

Proof. Adding entries of last column, we get $R_1(G)$.

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u + r_v$	$f \cdot (r_u + r_v)$
{3,2}	2	5	10
{3,1}	$3n - 2$	4	$12n - 8$
{2,2}	$n + 2m - 2$	4	$4n + 8m - 8$
{2,1}	$2n + 4m - 2$	3	$6n + 12m - 6$
{1,1}	$15mn - 10n - 8m + 5$	2	$30mn - 20n - 16m + 10$

Revan first polynomial is $R_1(G,x) = \sum_{uv\in E(G)} x^{(r_u + r_v)} = 2x^5 + (n + 2m - 2)x^4$

$+(2n + 4m - 2)x^3$+$(15mn - 10n - 8m + 5)x^2$.

Adding entries of last column, we get $R_2(G)$

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
{3,2}	2	6	12
{3,1}	$3n - 2$	3	$9n - 6$
{2,2}	$n + 2m - 2$	4	$4n + 8m - 8$
{2,1}	$2n + 4m - 2$	2	$4n + 8m - 4$
{1,1}	$15mn - 10n - 8m + 5$	1	$15mn - 10n - 8m + 5$

Revan second polynomial is

$R_2(G,x) = \sum_{uv\in E(G)} x^{(r_u \cdot r_v)} = 2x^6 + (n + 2m - 2)x^4 + (3n - 2)x^3 + +(2n + 4m - 2)x^2 + (15mn - 10n - 8m + 5)x$

Adding entries of last column, we get $R_3(G)$

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$\|r_u - r_v\|$	$f \cdot \|r_u - r_v\|$
{3,2}	2	1	2
{3,1}	$3n - 2$	2	$6n - 4$
{2,2}	$n + 2m - 2$	0	0
{2,1}	$2n + 4m - 2$	1	$2n + 4m - 2$
{1,1}	$15mn - 10n - 8m + 5$	0	0

Revan third polynomial is $R_3(G,x) = \sum_{uv\in E(G)} x^{|r_u - r_v|} = (3n - 2)x^2 + (2n + 4m)x + (15mn - 9n - 6m + 3)$.

Theorem 3.8. Let $SiC_4 - II[n,m], n,m \geq 1$ be the silicon carbide graph, then

1. $R_1(G) = \begin{cases} 30mn + 8n - 4m + 4 \text{ for } m = 1, n \geq 1 \\ 30mn + 8n + 4m - 4 \text{ for } m > 1, n \geq 1 \end{cases}$
2. $R_2(G) = \begin{cases} 15mn + 17n - 2m + 10 \text{ for } m = 1, n \geq 1 \\ 15mn - 14n + 6m + 2 \text{ for } m > 1, n \geq 1 \end{cases}$
3. $R_3(G) = \begin{cases} 6n - 4 & \text{for } m = 1, n \geq 1 \\ 12n + 8m - 12 & \text{for } m > 1, n \geq 1 \end{cases}$

Proof.

Proof. Adding entries of last column, we get $R_1(G)$ for $m = 1, n \geq 1$.

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u + r_v$	$f \cdot (r_u + r_v)$
{3,2}	2	5	10
{2,2}	$5n + 2$	4	$20n + 4$
{2,1}	$6n - 6$	3	$18n - 18$
{1,1}	$15mn - 15n - 2m + 2$	2	$30mn - 30n - 4m + 4$

Adding entries of last column, we get $R_1(G)$ for $m > 1$, $n \geq 1$.

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u + r_v$	$f \cdot (r_u + r_v)$
{3,2}	2	5	10
{2,2}	$2n + 2$	4	$8n + 8$
{2,1}	$12n + 8m - 14$	3	$36n + 24m - 42$
{1,1}	$15mn - 18n - 10m + 10$	2	$30mn - 36n - 20m + 20$

Revan first polynomial $R_1(G,x)$ for $m = 1, n \geq 1$ is

$\sum_{uv\in E(G)} x^{(r_u + r_v)} = 2x^5 + (5n + 2)x^4$+ $(6n - 6)x^3$+ $(15mn - 15n - 2m + 2)x^2$.

Revan first polynomial for $m > 1, n \geq 1$ is

$R_1(G,x) = 2x^5 + (2n + 2)x^4$+ $(12n + 8m - 14)x^3$+ $(15mn - 18n - 10m + 10)x^2$.

Adding entries of last column, we get

$R_2(G)$ for $m = 1, n \geq 1$

$\{r_u, r_v\}$	$f = \|RE_{u,v}\|$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
{3,2}	2	6	12
{2,2}	$5n + 2$	4	$20n + 8$
{2,1}	$6n - 6$	2	$12n - 12$
{1,1}	$15mn - 15n - 2m + 2$	1	$15mn - 15n - 2m + 2$

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Adding entries of last column, we get $R_2(G)$ for $m > 1$, $n \geq 1$.

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$r_u \cdot r_v$	$f \cdot (r_u \cdot r_v)$
$\{3,2\}$	2	6	12
$\{2,2\}$	$2n + 2$	4	$8n + 8m$
$\{2,1\}$	$12n + 8m - 14$	2	$24n + 16m - 28$
$\{1,1\}$	$15mn - 18n - 10m + 10$	1	$15mn - 18n - 10m + 10$

Revan second polynomial $R_2(G,x)$ $for\ m = 1, n \geq 1$

$\sum_{uv\in E(G)} x^{(r_u \cdot r_v)} = 2x^6 + (2n+2)x^4 + (12n + 8m - 14)x^2 + (15mn - 18n - 10m + 10)x.$

Revan second polynomial $for\ m > 1, n \geq 1$ is

$R_2(G,x) = 2x^6 + (5n+2)x^4 + (6n-6)x^2 + (15mn - 15n - 2m + 2)x.$

Adding entries of last column, we get

$R_3(G)$ for $m = 1, n \geq 1$.

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$\lvert r_u - r_v \rvert$	$f \cdot \lvert r_u - r_v \rvert$
$\{3,2\}$	2	1	2
$\{2,2\}$	$5n + 2$	0	0
$\{2,1\}$	$6n - 6$	1	$6n - 6$
$\{1,1\}$	$15mn - 15n - 2m + 2$	0	0

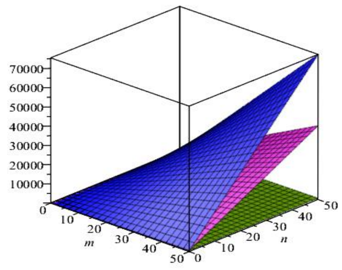
Adding entries of last column, we get $R_3(G)$ for $n > 1$, $m \geq 1$.

$\{r_u, r_v\}$	$f = \lvert RE_{u,v} \rvert$	$\lvert r_u - r_v \rvert$	$f \cdot \lvert r_u - r_v \rvert$
$\{3,2\}$	2	1	2
$\{2,2\}$	$2n + 2$	0	0
$\{2,1\}$	$12n + 8m - 14$	1	$12n + 8m - 14$
$\{1,1\}$	$15mn - 18n - 10m + 10$	0	0

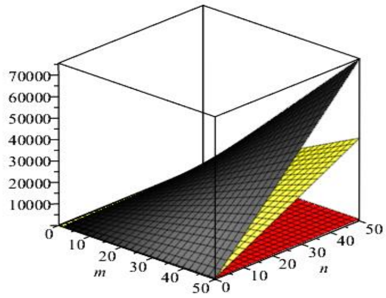
Revan third polynomial is $R_3(G,x)$ for $m = 1, n \geq 1$
$\sum_{uv\in E(G)} x^{\lvert r_u - r_v \rvert} = (6n-4)x + (15mn - 10n - 2m + 4).$
Revan third polynomial for $m > 1, n \geq 1$ is
$R_3(G,x) = (12n + 8m - 12)x + (15mn - 16n - 10m + 12).$

IV. ANALYSIS

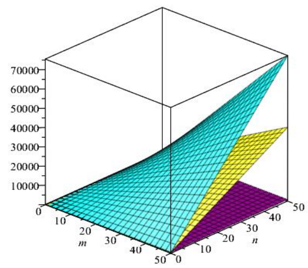
- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ for $Si_2C_3 - I[n,m]$. Blue color sheet represents Revan first index, purple color sheet represents Revan second index and green color sheet represents Revan third index.



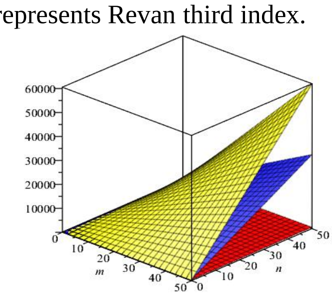
- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ of $Si_2C_3 - II[n,m]$. Black color sheet represents Revan first index, yellow color sheet represents Revan second index and red color sheet represents Revan third index.



- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ of $Si_2C_3 - III[n,m]$. Sky color sheet represents Revan first index, yellow color sheet represents Revan second index and purple color sheet represents Revan third index.



- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ of $SiC_3 - I[n,m]$. Yellow color sheet represents Revan first index, blue color sheet represents Revan second index and red color sheet represents Revan third index.



- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ of $SiC_3 - II[n,m]$. White color sheet represents Revan first index, sea green color sheet represents Revan second index and yellow color sheet represents Revan third index.

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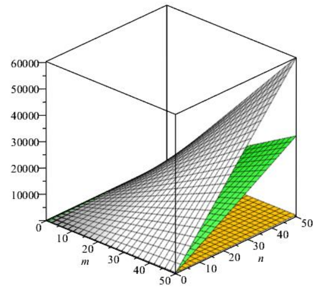
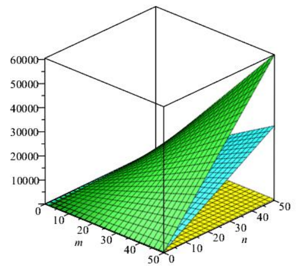
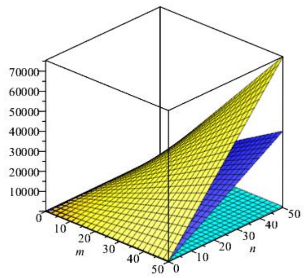


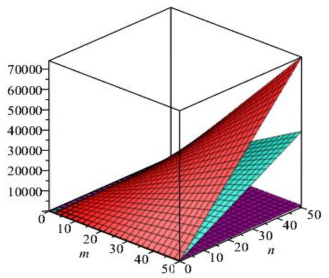
- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ of $SiC_3 - III[n, m]$. Green color sheet represents Revan first index, sky blue color sheet represents Revan second index and yellow color sheet represents Revan third index.



- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ of $SiC_4 - I[n, m]$. Yellow color sheet represents Revan first index, blue color sheet represents Revan second index and sky blue color sheet represents Revan third index.



- Comparison of Revan first index $R_1(G)$, Revan second index $R_2(G)$ and Revan third index $R_3(G)$ of $SiC_4 - I[n, m]$. Red color sheet represents Revan first index, sky blue color sheet represents Revan second index and purple color sheet represents Revan third index.



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