International Journal of Mathematical Archive-14(8), 2023, 1-7
Available online through www.ijma.info ISSN 2229 – 5046

IRREGULARITY DOMINATION NIRMALA AND DOMINATION SOMBOR INDICES OF CERTAIN DRUGS

V. R. KULLI*
Department of Mathematics, Gulbarga University, Gulbarga 585106, India.

(Received On: 14-07-23; Revised & Accepted On: 02-08-23)

ABSTRACT

In this paper, we introduce the irregularity domination Nirmala index, the irregularity domination Sombor index and their corresponding exponentials of a graph. Also we compute these newly defined irregularity domination indices and their corresponding exponentials for some important chemical drugs which are appeared in medical science.

Keywords: *irregularity domination Nirmala index, irregularity domination Sombor index, chemical drug.*

Mathematics Subject Classification: *05C10, 05C69.*

1. INTRODUCTION

The simple, connected graph G is with vertex set $V(G)$ and edge set $E(G)$. The number of vertices adjacent to the vertex u called degree of u, denoted by $d_G(u)$. For other graph terminologies and notions, the readers are referred to books [1, 2].

A chemical graph is a graph whose vertices correspond to the atoms and edges to the bonds. Mathematical Chemistry is very useful in the study of Chemical Sciences. We have found many applications in Mathematical Chemistry by using graph indices, especially in QSPR/QSAR research [3, 4].

In [5], the domination Nirmala index of a graph G was introduced and it is defined as

$$DN(G) = \sum_{uv\in E(G)} \sqrt{d_d(u) + d_d(v)}.$$

Recently, some domination indices were studied, for example, in [6, 7, 8, 9, 10, 11, 12] and some Nirmala indices were studied, for example, in [13, 14, 15, 16, 17, 18, 19, 20].

We introduce the irregularity domination Nirmala index of a graph G and it is defined as

$$IDN(G) = \sum_{uv\in E(G)} \sqrt{\left|d_d(u) - d_d(v)\right|}.$$

We introduce the irregularity domination Nirmala exponential of a graph G and it is defined as

$$IDN(G,x) = \sum_{uv\in E(G)} x^{\sqrt{\left|d_d(u) - d_d(v)\right|}}.$$

Recently, some irregularity indices were studied, for example, in [21, 22, 23, 24, 25, 16, 27, 28].

In [29], the domination Sombor index of a graph G was introduced and it is defined as

$$DSO(G) = \sum_{uv\in E(G)} \sqrt{d_d(u)^2 + d_d(v)^2}.$$

We introduce the irregularity domination Sombor index of a graph G and it is defined as

$$IDSO(G) = \sum_{uv\in E(G)} \sqrt{\left|d_d(u)^2 - d_d(v)^2\right|}.$$

Corresponding Author: V. R. Kulli*
Department of Mathematics, Gulbarga University, Gulbarga 585106, India.

We define the irregularity domination Sombor exponential of a graph G as

$$IDSO(G,x)=\sum_{uv\in E(G)} x^{\sqrt{\left|d_d(u)^2-d_d(v)^2\right|}}.$$

Recently, some Sombor indices were studied, for example, in [30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42].

In this paper, the irregularity domination Nirmala index, the irregularity domination Sombor index and their corresponding exponentials for chloroquine and hydroxychloroquine are determined.

2. RESULTS FOR CHLOROQUINE

Chloroquine is an antiviral compound (drug) which was discovered in 1934 by H.Andersag. This drug is medication primarily used to prevent and treat malaria.
Let G be the chemical structure of chloroquine. This structure has 21 vertices and 23 edges, see Figure 1.

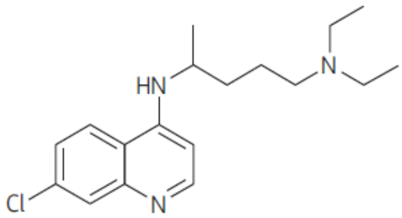

Figure-1: Chemical structure of chloroquine

From Figure 1, we obtain that $\{(d_d(u), d_d(v)) \setminus uv\in E(G)\}$ has 16 edge set partitions,
Table 2. [43] Edge partition based on the domination degree of end vertices of each edge of chloroquine

Table-1: Edge set partitions of chloroquine

	(216,288)				
$d_d(u), d_d(v) \setminus uv\in E(G)$	2	(216,264)	(216,216)	(324,324)	(297,324)
Number of edges	(240,408)	2	2	4	2
	1	(240,264)	(144,204)	(246,288)	(144,384)
	(288,384)	1	1	1	1
	1	(216,384)	(216,240)	(240,324)	(216,324)
	(216,297)	1	1	1	1
	1				

In the following theorem, we compute the irregularity domination Nirmala index of chloroquine.

Theorem 1: The irregularity domination Nirmala index of chloroquine is given by

$$IDN(G)=145.014251801$$

Proof: Applying definition and bond partition of chloroquine, we conclude

$$\begin{aligned}
IDN(G)&=\sum_{uv\in E(G)}\sqrt{\left|d_d(u)-d_d(v)\right|}\\
&=2\sqrt{|216-288|}+2\sqrt{|216-264|}+2\sqrt{|216-216|}+4\sqrt{|324-324|}+2\sqrt{|297-324|}\\
&+1\sqrt{|240-408|}+1\sqrt{|240-264|}+1\sqrt{|144-204|}+1\sqrt{|246-288|}+1\sqrt{|144-384|}\\
&+1\sqrt{|288-384|}+1\sqrt{|216-384|}+1\sqrt{|216-240|}+1\sqrt{|240-324|}+1\sqrt{|216-324|}\\
&+1\sqrt{|216-297|}.\\
&=2\sqrt{72}+2\sqrt{48}+0+0+2\sqrt{27}+1\sqrt{168}+1\sqrt{24}+1\sqrt{60}+1\sqrt{42}+1\sqrt{240}\\
&+1\sqrt{96}+1\sqrt{168}+1\sqrt{24}+1\sqrt{84}+1\sqrt{108}+1\sqrt{81}.
\end{aligned}$$

By solving the above equation, we get the desired result.

We calculate the irregularity domination Nirmala exponential of chloroquine as follows:

Theorem 2: The irregularity domination Nirmala exponential of chloroquine is given by

$$IDN(G,x)=2x^{\sqrt{72}}+2x^{\sqrt{48}}+6+2x^{\sqrt{27}}+2x^{\sqrt{168}}+2x^{\sqrt{24}}+x^{\sqrt{60}}+x^{\sqrt{42}}+x^{\sqrt{240}}$$
$$+x^{\sqrt{96}}+x^{\sqrt{84}}+x^{\sqrt{108}}+x^{\sqrt{81}}.$$

Proof: Applying definition and edge partition of chloroquine, we conclude

$$IDN(G,x)=\sum_{uv\in E(G)} x^{\sqrt{|d_d(u)-d_d(v)|}}$$
$$=2x^{\sqrt{|216-288|}}+2x^{\sqrt{|216-264|}}+2x^{\sqrt{|216-216|}}+4x^{\sqrt{|324-324|}}+2x^{\sqrt{|297-324|}}+1x^{\sqrt{|240-408|}}$$
$$+1x^{\sqrt{|240-264|}}+1x^{\sqrt{|144-204|}}+1x^{\sqrt{|246-288|}}+1x^{\sqrt{|144-384|}}+1x^{\sqrt{|288-384|}}+1x^{\sqrt{|216-384|}}$$
$$+1x^{\sqrt{|216-240|}}+1x^{\sqrt{|240-324|}}+1x^{\sqrt{|216-324|}}+1x^{\sqrt{|216-297|}}.$$
$$=2x^{\sqrt{72}}+2x^{\sqrt{48}}+2x^{0}+4x^{0}+2x^{\sqrt{27}}+1x^{\sqrt{168}}+1x^{\sqrt{24}}+1x^{\sqrt{60}}+1x^{\sqrt{42}}+1x^{\sqrt{240}}$$
$$+1x^{\sqrt{96}}+1x^{\sqrt{168}}+1x^{\sqrt{24}}+1x^{\sqrt{84}}+1x^{\sqrt{108}}+1x^{\sqrt{81}}.$$

By solving the above equation, we get the desired result.

In the following theorem, we compute the irregularity domination Sombor index of chloroquine.

Theorem 3: The irregularity domination Sombor index of chloroquine is given by

$$IDSO(G)=3372.80249809$$

Proof: Applying definition and edge partition of chloroquine, we conclude

$$IDSO(G)=\sum_{uv\in E(G)}\sqrt{\left|d_d(u)^2-d_d(v)^2\right|}$$
$$=2\sqrt{|216^2-288^2|}+2\sqrt{|216^2-264^2|}+2\sqrt{|216^2-216^2|}+4\sqrt{|324^2-324^2|}+2\sqrt{|297^2-324^2|}$$
$$+1\sqrt{|240^2-408^2|}+1\sqrt{|240^2-264^2|}+1\sqrt{|144^2-204^2|}+1\sqrt{|246^2-288^2|}+1\sqrt{|144^2-384^2|}$$
$$+1\sqrt{|288^2-384^2|}+1\sqrt{|216^2-384^2|}+1\sqrt{|216^2-240^2|}+1\sqrt{|240^2-324^2|}+1\sqrt{|216^2-324^2|}$$
$$+1\sqrt{|216^2-297^2|}.$$
$$=2\sqrt{36288}+2\sqrt{23040}+0+0+2\sqrt{16767}+1\sqrt{108864}+1\sqrt{12096}+1\sqrt{20880}$$
$$+1\sqrt{22428}+1\sqrt{126720}+1\sqrt{64512}+1\sqrt{100800}+1\sqrt{10944}+1\sqrt{47376}+1\sqrt{58320}+1\sqrt{41553}.$$

By solving the above equation, we get the desired result.

We compute the irregularity domination Sombor exponential of chloroquine as follows:

Theorem 4: The irregularity domination Sombor exponential of chloroquine is given by

$$IDSO(G,x)=2x^{\sqrt{36288}}+2x^{\sqrt{23040}}+6+2x^{\sqrt{16767}}+x^{\sqrt{108864}}+x^{\sqrt{12096}}+x^{\sqrt{20880}}$$
$$+x^{\sqrt{22428}}+x^{\sqrt{126720}}+x^{\sqrt{64512}}+x^{\sqrt{100800}}+x^{\sqrt{10944}}+x^{\sqrt{47376}}+x^{\sqrt{58320}}+x^{\sqrt{41553}}.$$

Proof: Applying definition and edge partition of chloroquine, we conclude

$$IDSO(G,x)=\sum_{uv\in E(G)} x^{\sqrt{|d_d(u)^2-d_d(v)^2|}}$$
$$=2x^{\sqrt{|216^2-288^2|}}+2x^{\sqrt{|216^2-264^2|}}+2x^{\sqrt{|216^2-216^2|}}+4x^{\sqrt{|324^2-324^2|}}+2x^{\sqrt{|297^2-324^2|}}+1x^{\sqrt{|240^2-408^2|}}$$
$$+1x^{\sqrt{|240^2-264^2|}}+1x^{\sqrt{|144^2-204^2|}}+1x^{\sqrt{|246^2-288^2|}}+1x^{\sqrt{|144^2-384^2|}}+1x^{\sqrt{|288^2-384^2|}}+1x^{\sqrt{|216^2-384^2|}}$$
$$+1x^{\sqrt{|216^2-240^2|}}+1x^{\sqrt{|240^2-324^2|}}+1x^{\sqrt{|216^2-324^2|}}+1x^{\sqrt{|216^2-297^2|}}.$$
$$=2x^{\sqrt{36288}}+2x^{\sqrt{23040}}+2x^{0}+4x^{0}+2x^{\sqrt{16767}}+1x^{\sqrt{108864}}+1x^{\sqrt{12096}}+1x^{\sqrt{20880}}$$
$$+1x^{\sqrt{22428}}+1x^{\sqrt{126720}}+1x^{\sqrt{64512}}+1x^{\sqrt{100800}}+1x^{\sqrt{10944}}+1x^{\sqrt{47376}}+1x^{\sqrt{58320}}+1x^{\sqrt{41553}}.$$

By solving the above equation, we get the desired result.

3. RESULTS FOR HYDROXYCHLOROQUINE

Hydroxychloroquine is another antiviral compound (drug) which has antiviral activity very similar to that of chloroquine. These compounds have been repurposed for the treatment of a number of other conditions including HIV, systemic lupus erythmatosus and rheumatoid arthritis .

Let H be the chemical structure of hydroxychloroquine. This structure has 22 vertices and 24 edges, see Figure 2.

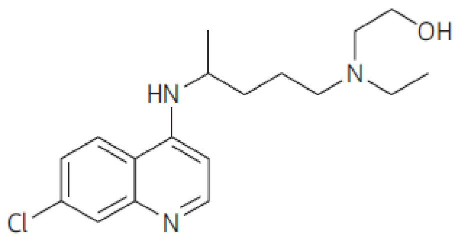

Figure-2: Chemical structure of hydroxychloroquine

From Figure 2, we obtain that $\{(d_d(u), d_d(v)) \setminus uv \in E(H)\}$ has 21 edge set partitions,

Table 2. [43] Bond partition based on the domination degree of end vertices of each edge of hydroxychloroquine.

$d_d(u), d_d(v) \setminus uv \in E(H)$	(210,350)	(210,425)	(207,324)	(207,567)	(315,317)
Number of edges	1	1	1	1	1
	(315,385)	(315,420)	(315,425)	(317,340)	(317,385)
	1	2	1	1	1
	(324,324)	(324,459)	(324,567)	(324,621)	(340,486)
	1	1	1	1	1
	(350,385)	(350,595)	(385,420)	(420,425)	(459,486)
	1	1	1	1	3
	(486,567)				
	1				

In the following theorem, we determine the irregularity domination Nirmala index of hydroxychloroquine.

Theorem 5: The irregularity domination Nirmala index of hydroxychloroquine is given by

$$IDN(H) = 220.923506142$$

Proof: Applying definition and edge partition of hydroxychloroquine, we conclude

$$IDN(H) = \sum_{uv \in E(H)} \sqrt{|d_d(u) - d_d(v)|}$$

$$\begin{aligned}
&= 1\sqrt{|210-350|} + 1\sqrt{|210-425|} + 1\sqrt{|207-324|} + 1\sqrt{|207-567|} + 1\sqrt{|315-317|} \\
&+ 1\sqrt{|315-385|} + 2\sqrt{|315-420|} + 1\sqrt{|315-425|} + 1\sqrt{|317-340|} + 1\sqrt{|317-385|} \\
&+ 1\sqrt{|324-324|} + 1\sqrt{|324-459|} + 1\sqrt{|324-567|} + 1\sqrt{|324-621|} + 1\sqrt{|340-486|} \\
&+ 1\sqrt{|350-385|} + 1\sqrt{|350-595|} + 1\sqrt{|385-420|} + 1\sqrt{|420-425|} + 3\sqrt{|459-486|} \\
&+ 1\sqrt{|486-567|}. \\
&= 1\sqrt{140} + 1\sqrt{215} + 1\sqrt{117} + 1\sqrt{360} + 1\sqrt{2} + 1\sqrt{70} + 2\sqrt{105} \\
&+ 1\sqrt{110} + 1\sqrt{23} + 1\sqrt{68} + 0 + 1\sqrt{135} + 1\sqrt{243} + 1\sqrt{297} \\
&+ 1\sqrt{146} + 1\sqrt{35} + 1\sqrt{245} + 1\sqrt{35} + 1\sqrt{5} + 3\sqrt{27} + 1\sqrt{81}.
\end{aligned}$$

By solving the above equation, we get the desired result.

We now compute the irregularity domination Nirmala index of hydroxychloroquine.

Theorem 6: The irregularity domination Nirmala exponential of chloroquine is given by

$$\begin{aligned} IDN(H,x) &= x^{\sqrt{140}} + x^{\sqrt{215}} + x^{\sqrt{117}} + x^{\sqrt{360}} + x^{\sqrt{2}} + x^{\sqrt{70}} + 2x^{\sqrt{105}} \\ &\quad + x^{\sqrt{110}} + x^{\sqrt{23}} + x^{\sqrt{68}} + 1 + x^{\sqrt{135}} + x^{\sqrt{243}} + x^{\sqrt{297}} \\ &\quad + x^{\sqrt{146}} + 2x^{\sqrt{35}} + x^{\sqrt{245}} + x^{\sqrt{5}} + 3x^{\sqrt{27}} + x^{\sqrt{81}}. \end{aligned}$$

Proof: Applying definition and edge partition of chloroquine, we conclude

$$\begin{aligned} IDN(H,x) &= \sum_{uv\in E(H)} x^{\sqrt{|d_d(u)-d_d(v)|}} \\ &= 1x^{\sqrt{|210-350|}} + 1x^{\sqrt{|210-425|}} + 1x^{\sqrt{|207-324|}} + 1x^{\sqrt{|207-567|}} + 1x^{\sqrt{|315-317|}} \\ &\quad + 1x^{\sqrt{|315-385|}} + 2x^{\sqrt{|315-420|}} + 1x^{\sqrt{|315-425|}} + 1x^{\sqrt{|317-340|}} + 1x^{\sqrt{|317-385|}} \\ &\quad + 1x^{\sqrt{|324-324|}} + 1x^{\sqrt{|324-459|}} + 1x^{\sqrt{|324-567|}} + 1x^{\sqrt{|324-621|}} + 1x^{\sqrt{|340-486|}} \\ &\quad + 1x^{\sqrt{|350-385|}} + 1x^{\sqrt{|350-595|}} + 1x^{\sqrt{|385-420|}} + 1x^{\sqrt{|420-425|}} + 3x^{\sqrt{|459-486|}} + 1x^{\sqrt{|486-567|}}. \\ &= 1x^{\sqrt{140}} + 1x^{\sqrt{215}} + 1x^{\sqrt{117}} + 1x^{\sqrt{360}} + 1x^{\sqrt{2}} + 1x^{\sqrt{70}} + 2x^{\sqrt{105}} \\ &\quad + 1x^{\sqrt{110}} + 1x^{\sqrt{23}} + 1x^{\sqrt{68}} + 1x^{0} + 1x^{\sqrt{135}} + 1x^{\sqrt{243}} + 1x^{\sqrt{297}} \\ &\quad + 1x^{\sqrt{146}} + 1x^{\sqrt{35}} + 1x^{\sqrt{245}} + 1x^{\sqrt{35}} + 1x^{\sqrt{5}} + 3x^{\sqrt{27}} + 1x^{\sqrt{81}}. \end{aligned}$$

By solving the above equation, we get the desired result.

In the following theorem, we calculate the irregularity domination Sombor index of hydroxychloroquine.

Theorem 7: The irregularity domination Sombor index of hydroxychloroquine is given by

$$IDSO(H) = 6258.46669388$$

Proof: Applying definition and edge partition of hydroxychloroquine, we conclude

$$\begin{aligned} IDSO(H) &= \sum_{uv\in E(H)} \sqrt{\left|d_d(u)^2 - d_d(v)^2\right|} \\ &= 1\sqrt{|210^2-350^2|} + 1\sqrt{|210^2-425^2|} + 1\sqrt{|207^2-324^2|} + 1\sqrt{|207^2-567^2|} + 1\sqrt{|315^2-317^2|} \\ &\quad + 1\sqrt{|315^2-385^2|} + 2\sqrt{|315^2-420^2|} + 1\sqrt{|315^2-425^2|} + 1\sqrt{|317^2-340^2|} + 1\sqrt{|317^2-385^2|} \\ &\quad + 1\sqrt{|324^2-324^2|} + 1\sqrt{|324^2-459^2|} + 1\sqrt{|324^2-567^2|} + 1\sqrt{|324^2-621^2|} + 1\sqrt{|340^2-486^2|} \\ &\quad + 1\sqrt{|350^2-385^2|} + 1\sqrt{|350^2-595^2|} + 1\sqrt{|385^2-420^2|} + 1\sqrt{|420^2-425^2|} + 3\sqrt{|459^2-486^2|} \\ &\quad + 1\sqrt{|486^2-567^2|}. \\ &= 1\sqrt{78400} + 1\sqrt{140224} + 1\sqrt{64575} + 1\sqrt{281088} + 1\sqrt{1264} + 1\sqrt{49000} + 2\sqrt{77175} \\ &\quad + 1\sqrt{81400} + 1\sqrt{15111} + 1\sqrt{47736} + 0 + 1\sqrt{23905} + 1\sqrt{216513} + 1\sqrt{280665} \\ &\quad + 1\sqrt{120596} + 1\sqrt{104125} + 1\sqrt{309925} + 1\sqrt{28175} + 1\sqrt{4225} + 3\sqrt{25515} + 1\sqrt{85293}. \end{aligned}$$

By solving the above equation, we get the desired result.

In the following theorem, we compute the irregularity domination Sombor exponential of chloroquine.

Theorem 8: The irregularity domination Sombor exponential of chloroquine is given by

$$\begin{aligned} IDSO(H,x) &= x^{\sqrt{78400}} + x^{\sqrt{140224}} + x^{\sqrt{64575}} + x^{\sqrt{281088}} + x^{\sqrt{1264}} + x^{\sqrt{49000}} + 2x^{\sqrt{77175}} \\ &\quad + x^{\sqrt{81400}} + x^{\sqrt{15111}} + x^{\sqrt{15111}} + x^{0} + x^{\sqrt{23905}} + x^{\sqrt{216513}} + x^{\sqrt{280665}} \\ &\quad + x^{\sqrt{120596}} + x^{\sqrt{104125}} + x^{\sqrt{309925}} + x^{\sqrt{28175}} + x^{\sqrt{4225}} + 3x^{\sqrt{25515}} + x^{\sqrt{85293}}. \end{aligned}$$

Proof: Applying definition and edge partition of chloroquine, we conclude

$$
\begin{aligned}
IDSO(H,x) &= \sum_{uv\in E(H)} x^{\sqrt{\left|d_d(u)^2-d_d(v)^2\right|}} \\
&= 1x^{\sqrt{|210^2-350^2|}} + 1x^{\sqrt{|210^2-425^2|}} + 1x^{\sqrt{|207^2-324^2|}} + 1x^{\sqrt{|207^2-567^2|}} + 1x^{\sqrt{|315^2-317^2|}} \\
&\quad + 1x^{\sqrt{|315^2-385^2|}} + 2x^{\sqrt{|315^2-420^2|}} + 1x^{\sqrt{|315^2-425^2|}} + 1x^{\sqrt{|317^2-340^2|}} + 1x^{\sqrt{|317^2-385^2|}} \\
&\quad + 1x^{\sqrt{|324^2-324^2|}} + 1x^{\sqrt{|324^2-459^2|}} + 1x^{\sqrt{|324^2-567^2|}} + 1x^{\sqrt{|324^2-621^2|}} + 1x^{\sqrt{|340^2-486^2|}} \\
&\quad + 1x^{\sqrt{|350^2-385^2|}} + 1x^{\sqrt{|350^2-595^2|}} + 1x^{\sqrt{|385^2-420^2|}} + 1x^{\sqrt{|420^2-425^2|}} + 3x^{\sqrt{|459^2-486^2|}} \\
&\quad + 1x^{\sqrt{|486^2-567^2|}}. \\
&= 1x^{\sqrt{78400}} + 1x^{\sqrt{140224}} + 1x^{\sqrt{64575}} + 1x^{\sqrt{281088}} + 1x^{\sqrt{1264}} + 1x^{\sqrt{49000}} + 2x^{\sqrt{77175}} \\
&\quad + 1x^{\sqrt{81400}} + 1x^{\sqrt{15111}} + 1x^{\sqrt{15111}} + x^{0} + 1x^{\sqrt{23905}} + 1x^{\sqrt{216513}} + 1x^{\sqrt{280665}} \\
&\quad + 1x^{\sqrt{120596}} + 1x^{\sqrt{104125}} + 1x^{\sqrt{309925}} + 1x^{\sqrt{28175}} + 1x^{\sqrt{4225}} + 3x^{\sqrt{25515}} + 1x^{\sqrt{85293}}.
\end{aligned}
$$

By solving the above equation, we get the desired result.

4. CONCLUSION

In this study, we have determined the irregularity domination Nirmala index, the irregularity domination Sombor index and their corresponding exponentials for some important drugs such as chloroquine, hydroxychloroquine which are appeared in medical science.

REFERENCES

1. V.R.Kulli, *College Graph Theory*, Vishwa International Publications, Gulbarga, India (2012).
2. V.R.Kulli, *Theory of Domination in Graphs,* Vishwa International Publications, Gulbarga, India (2010).
3. S.Wagner and H.Wang, *Introduction Chemical Graph Theory,* Boca Raton, CRC Press, (2018).
4. M.V.Diudea (ed.) *QSPR/QSAR Studies by Molecular Descriptors,* NOVA New York, (2001).
5. V.R.Kulli, Domination Nirmala indices of graphs, *International Journal of Mathematics and Computer Research,* 11(6) (2023) 3497-3502.
6. A.M.Hanan Ahmed, A.Alwardi and M.Ruby Salestina, On domination topological indices of graphs, *International Journal of Analysis and Applications,* 19(1) (2021) 47-64.
7. V.R.Kulli, Domination Dharwad indices of graphs, submitted.
8. V.R.Kulli, Domination product connectivity indices of graphs, *Annals of Pure and Applied Mathematics,* 27(2) (2023) 73-78.
9. V.R.Kulli, Multiplicative domination Nirmala indices of graphs, *International Journal of Mathematics and its Applications,* 11(3) (2023) 11-20.
10. V.R.Kulli, Domination augmented Banhatti, domination augmented Banhatti sum indices of certain chemical drugs, *International Journal of Mathematics and Computer Research,* 11(7) (2023) 3558-3564.
11. V.R.Kulli, Domination atom bond sum connectivity indices of certain nanostructures, *International Journal of Engineering Sciences and Research Technology,* 12(7) (2023).
12. S.Raju, Puttuswamy and S.R.Nayaka, On the second domination hyper index of graph and some graph operations, *Advances and Applications in Discrete Mathematics*, 39(1) (2023) 125-143.
13. Mohit R. Nandargi and V.R.Kulli, The (*a*, *b*)-Nirmala index, *International Journal of Engineering Sciences and Research Technology*, 11(2) (2022) 37-42.
14. V.R.Kulli, Status Nirmala index and its exponential of a graph, *Annals of Pure and Applied Mathematics,* 25(2) (2021) 85-90.
15. V.R.Kulli, B.Chaluvaraju and T.V.Asha, Computation of Nirmala indices of some chemical networks, *Journal of Ultra Scientists of Physical Sciences-A,* 33(4) (2021) 30-41.
16. V.R.Kulli, HDR Nirmala index, *International Journal of Mathematics and Computer Research,* 10(7) (2022) 2796-2800.
17. V.R.Kulli, Reverse Nirmala index, *International Journal of Engineering Sciences and Research Technology,* 10(8) (2022) 12-19.
18. V.R.Kulli, Revan Nirmala index, *Annals of Pure and Applied Mathematics,* 26(1) (2022) 7-13.
19. V.R.Kulli, Edge versions of Sombor and Nirmala indices of some nanotubes and nanotori, *International Journal of Mathematics and Computer Research*, 11(3) (2023) 3305-3310.
20. V.R.Kulli, Gourava Nirmala indices of certain nanostructures, *International Journal of Mathematical Archive,* 14(2) (2023) 1-9.
21. V.R.Kulli, Irregularity neighborhood Dharwad index and its exponential of some nanostar dendrimers, *International Journal of Engineering Sciences and Research Technology,* 12(5) (2023) 18-24.

22. M.Albertson, The irregularity of a graph, *Ars Comb.* 46 (1997) 129-125.
23. W.Gao and H.Abdo and D.Dimitrov, On the irregularity of some molecular structures, *Can. J. Chem.* 95 (2017) 174-183.
24. I.Gutman, Topological indices and irregularity measures, *Bulletin of Society of Mathematicians*, 8 (2018) 469-475.
25. V.R.Kulli, New irregularity Sombor indices and new Adriatic (a, b)-*KA* indices of certain chemical drugs, *International Journal of Mathematics Trends and Technology,* 67(9) (2021) 105-113.
26. V.R.Kulli, New irregularity Nirmala indices of some chemical structures, *International Journal of Engineering Sciences and Research Technology,* 10(8) (2021) 33-42.
27. T.Reti, R.Sharfdini, A.Dregelyi-Kiss and H.Hagobin, Graph irregularity indices used as molecular discriptors in QSPR studies, *MATCH Commun. Math. Comput. Chem.* 79 (2018) 509-524.
28. B.Zhou and W.Luo, On irregularity of graphs, *ARS Comb.* 88 (2008) 55-64.
29. A.A.Shashidhar, H.Ahmed, N.D.Soner and M.Cancan, Domination version: Sombor index of graphs and its significance in predicting physicochemical properties of butane derivatives, *Eurasian Chemical Communications,* 5 (2023) 91-102.
30. V.R.Kulli, Revan Sombor indices and their exponentials for certain nanotubes, *International Journal of Engineering Sciences and Research Technology,* 11(5) (2022) 22-31.
31. V.R.Kulli, N.Harish, and B.Chaluvaraju, Sombor leap indices of some chemical drugs, *RESEARCH REVIEW International Journal of Multidisciplinary,* 7(10) (2022) 158-166.
32. V.R.Kulli, J.A.Mendez-Bermudez, J.M.Rodriguez and J.M.Sigarreta, Revan Sombor indices: Analytical and statistical study, on random graphs, *Mathematical Boisciences and Engineering,* 20(2) (2022) 1801-1819.
33. H.R.Manjunatha, V.R.Kulli and N.D.Soner, The HDR Sombor index, *International Journal of Mathematics Trends and Technology,* 68(4) (2022) 1-6.
34. V.R.Kulli, Computation of reduced Kulli-Gutman Sombor index of certain networks, *Journal of Mathematics and Informatics,* 23 (2022) 1-5.
35. V.R.Kulli and I.Gutman, Sombor and *KG* Sombor indices of benzenoid systems and phenylenes, *Annals of Pure and Applied Mathematics,* 26(2) (2022) 49-53.
36. V.R.Kulli, Neighborhood Sombor indices, *International Journal of Mathematics Trends and Technology,* 68(6) (2022) 195-204.
37. V.R.Kulli, HDR Sombor indices and their exponentials of a graph, *International Journal of Mathematics and Computer Research,* 10(7) (2022) 2817-2921.
38. I.Gutman, I.Redzepovac and V.R.Kulli, *KG* Sombor index of Kragujevac trees, *Open Journal of disctrete Applied Mathematics,* 5(2) (2022) 19-25.
39. V.R.Kulli, F-Sombor and modified Sombor indices of certain nanotubes, *Annals of Pure and Applied Mathematics,* 27(1) (2023) 13-17.
40. V.R.Kulli, Gourava Sombor indices, *International Journal of Engineering Sciences and Research Technology,* 11(11) (2022) 29-38.
41. V.R.Kulli, E-Banhatti Sombor indices, *International Journal of Mathematics and Computer Research,* 10(12) (2022) 2986-2994.
42. V.R.Kulli, Multiplicative Revan Sombor indices of some benzenoid systems, *International Journal of Mathematics and Computer Research,* 10(10) (2022) 2947-2952.
43. H.Ahmed, A.Alwardi, M.Ruby Salestina and N.D.Soner, Domination, γ-domination topological indices and φ-polynomial of some chemical structures applied for the treatment of COVID-19 patients, *Biointerface Research in Applied Chemistry,* 11(5) (2021) 13290-13302.

Source of support: Nil, Conflict of interest: None Declared.