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Article

Topological Properties of Subdivided Hex-derived Networks

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Abstract: A non-empirical numerical value that grasp properties of molecular graph of chemical structure referred to as topological index. Topological indices of molecular graph are very useful for scientist to accomplish regression analysis in QSPR study. In this paper, we will use latest technique (Imbalanced based indices) to associate a numeric quantity with a the molecular graph of Subdivided Hex-derived networks SHN_t .

Keywords: Irregularity indices, Subdivided Hex-derived networks.

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1. Introduction and Preliminaries

T construction of SHN_t is simple. We can construct SHN_t by the subdivision of hexderived by adding extra points in every triangle the hexagonal mesh's face and then attach this extra point with all other existing points. In [1], one can find out an alternative construction of SHN_t. The comparison of HN_t and SHN_t shows that this new SHN_t derived network have some new and exiting properties. It presents the configuration like wise molecular lattice shapes in chemistry. Moreover SHN_t is a mesh network [2], mesh networks play an important rule in networking, where cost minimize problems exit.

In mathematical chemistry, graph theory offers the trusty tool that is used to compute the numerous types of chemical compounds and anticipate their various attributes. A topological index (TI), which is effective in predicting the chemical and physical properties of the underlying chemical compound, such as boiling point, strain energy, stiffness, heat of evaporation, tension, and so on, is one of the most crucial tools in chemical graph theory. [3,4]. A simple graph is one without several loops or edges. A molecular graph is a simple graph with the vertex and edge sets represent, respectively, atoms and bounds. The amount of edges that are connected to a vertex determines its degree. It is mostly interesting these characteristics of diverse. Winner discovered the boiling point in 1947 and introduced the first. In 1975, Gutman provided an impressive identity [5] about Zagreb indices. As a result, these two indices are some of the first degree-based descriptors, and substantial research has been done on their characteristics. These indices' mathematical formulas are: $\mathbb{G}$

$$M_1(\mathbb{G}) = \sum_{uv \in E(\mathbb{G})} (d_u + d_v),$$

$$M_2(\mathbb{G}) = \sum_{uv \in E(\mathbb{G})} (d_u \times d_v).$$

For various chemical architectures and networks, many authors calculated TIs, such as in [6], Amin et al. studied prism graphs. For the prism graph, they calculated M-polynomial and nine-degree based indices. TIs of Circulate graphs has been studied by Gao et al. in [7]. Dobrynin et al. in [8] talk about the wiener index for tree graphs. Researchers have looked into the idea of mathematical chemistry and its characteristics in [9]. Caporossi at al. in [10], describe the highest connection index for several graphs. Li and Gutman, With chemical graph theory, discuss the chemical composition of monographs [11]. Li and Shi in [12], gives a details analysis of famous Randić index. The survey on Zagreb indices was put forward by Nikolić et al. in [13]. Another survey on Zagreb indices was written by Gutman and Das in [14]. Virk et al. in [15], changed the Atomic Bond Connectivity Index definition that was previously provided and provided a new definition.

Shao et al. [16] gives topological characteristics of Bismuth Tri-Iodide. In [17], Virk et al. discuss the reverse Zagreb indices for Silicon Carbides.

A TI is recognized as Irregularity index, [18] if the value of TI of graph is higher or equal to zero and TI of graph will be zero if graph have homogenous degree of nodes throughout the graph. The Irregularity indices are listed below. The majority of irregularity indices used in quantitative structure activity relationship modelling come from the family of degree-based TIs. Mathematical definition of irregularity indices are in table 1,

Table 1. Definitions of Irregularity indices

Irregularity index	Mathematical Formula
VAR	$\sum_{u\epsilon V}(d_u-\frac{2m}{n})^2=\frac{M_1(\mathbb{G})}{n}-(\frac{2m}{n})^2$
AL	$\sum_{uv\in E(\mathbb{G})}\lvert d_u-d_v\rvert$
IR1	$\sum_{u\in V}(d_u)^3-\frac{2m}{n}\sum_{u\in V}(d_u)^2=F(\mathbb{G})-\frac{2m}{n}M_1(\mathbb{G})$
IR2	$\sqrt{\frac{\sum_{uv\in E(\mathbb{G})}d_ud_v}{m}}-\frac{2m}{n}=\sqrt{\frac{M_2(\mathbb{G})}{m}}-\frac{2m}{n}$
IRF	$\sum_{uv\in E(\mathbb{G})}(d_u-d_v)^2=F(\mathbb{G})-2M_2(\mathbb{G})$
IRFW	$\frac{IRF(\mathbb{G})}{M_2(\mathbb{G})}$
IRA	$\sum_{uv\in E(\mathbb{G})}(d_u^{-1/2}-d_v^{-1/2})^2=n-2R(\mathbb{G})$
IRB	$\sum_{uv\in E(\mathbb{G})}(d_u^{1/2}-d_v^{1/2})^2=M_1(\mathbb{G})-2RR(\mathbb{G})$
IRC	$\frac{\sum_{uv\in E(\mathbb{G})}\sqrt{d_ud_v}}{m}-\frac{2m}{n}=\frac{RR(\mathbb{G})}{m}-\frac{2m}{n}$
IRDIF	$\sum_{uv\in E(\mathbb{G})}\lvert\frac{d_u}{d_v}-\frac{d_v}{d_u}\rvert=\sum_{i<j}m_{i,j}(\frac{j}{i}-\frac{i}{j})$
IRL	$\sum_{uv\in E(\mathbb{G})}\lvert lnd_u-lnd_v\rvert=\sum_{i<j}m_{i,j}ln(\frac{j}{i})$
IRLU	$\sum_{uv\in E(\mathbb{G})}\frac{\lvert d_u-d_v\rvert}{min(d_u,d_v)}=\sum_{i<j}m_{i,j}ln(\frac{j-i}{i})$
IRLF	$\sum_{uv\in E(\mathbb{G})}\frac{\lvert d_u-d_v\rvert}{\sqrt{(d_ud_v)}}=\sum_{i<j}m_{i,j}(\frac{j-i}{\sqrt{ij}})$
IRLA	$2\sum_{uv\in E(\mathbb{G})}\frac{\lvert d_u-d_v\rvert}{(d_u+d_v)}=2\sum_{i<j}m_{i,j}(\frac{j-i}{i+j})$
IRDI	$\sum_{uv\in E(\mathbb{G})}ln1+\lvert d_u-d_v\rvert=\sum_{i<j}m_{i,j}ln(i+j-1)$
IRGA	$\sum_{uv\in E(\mathbb{G})}ln(\frac{d_u+d_v}{2\sqrt{d_ud_v}})\sum_{i<j}m_{i,j}(\frac{i+j}{2\sqrt{ij}})$

2. Irregularity indices for Subdivided Hex-derived networks SHN_t

The network under consideration SHN_t, obtain by carry out the subdivision of hex-derived network HN_t. Here, we'll talk about the erratic character of SHN_t graph with the help of irregularity indices. The 2D graph of SHN_t is given in Figure 2. From figure 2, we can see , that SHN_p graph have four different types of edges depending upon the degree of end vertices. Such that, $E(SHN_t)=\mathcal{P}_1+\mathcal{P}_2+\mathcal{P}_3+\mathcal{P}_4$ and the cardinality of $\lvert E(SHN_p)\rvert=27t^2-51t+24$ The extra knowledge for various edges of SHN_t is illustrated in Table 2.

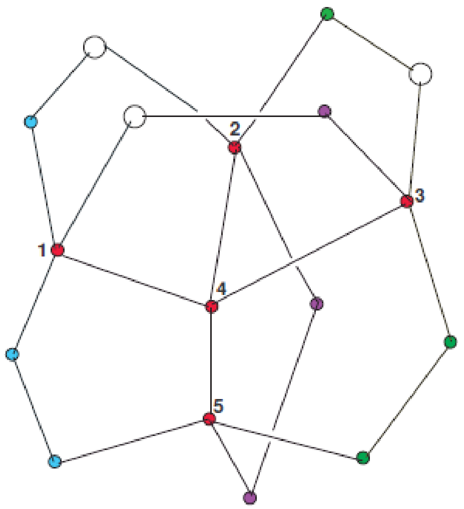

Figure 1. Subdivision of $K-5$ inside Simmons-Paquette molecular graph

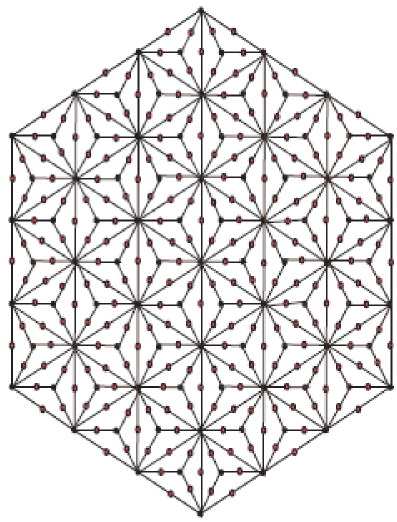

Figure 2. graph of SHN_t

Table 2. $E(SHN_t)$

Edge Division	Edge Splitting	Reoccurrence
$\mathcal{P}_1$	$\mathcal{P}_{(2,3)}$	$18t^2-36t+18$
$\mathcal{P}_2$	$\mathcal{P}_{(2,5)}$	30
$\mathcal{P}_3$	$\mathcal{P}_{(2,7)}$	$42t-84$
$\mathcal{P}_4$	$\mathcal{P}_{(2,12)}$	$36t^2-108t+84$

Theorem 1. *Let $\mathbb{G}$ be the graph of SHN_t. The Irregularity indices are*

1. $VAR(\mathbb{G}) = -\frac{2(1035t^4+1110t^3-5630t^2+5103t-1368)}{(9t^2-15t+7)^2}$
2. $AL(\mathbb{G}) = 378t^2-906t+528$
3. $IR1(\mathbb{G}) = \frac{6(3285t^4+102344t^3-361514t^2+401189t-143254)}{9t^2-15t+7}$

4. $IR2(\mathbb{G}) = \sqrt{\frac{972t^2-2220t+1248}{27t^2-51t+24}} - \frac{2(27t^2-51t+24)}{9t^2-15t+7}$
5. $IRF(\mathbb{G}) = 3618t^2 - 9786t + 6588$
6. $IRFW(\mathbb{G}) = \frac{3618t^2-9786t+6588}{972t^2-2220t+1248}$

Proof.

$$\begin{aligned} VAR(\mathbb{G}) &= \sum_{u\epsilon V}\left(d_u - \frac{2m}{n}\right)^2 = \frac{M_1(G)}{n} - \left(\frac{2m}{n}\right)^2 \\ &= \left(\frac{(94t^2-1314t+720)}{9t^2-15t+7}\right) - \left(\frac{2(27t^2-51t+24)}{(9t^2-15t+7)}\right)^2 \\ &= -\frac{2(1035t^4+1110t^3-5630t^2+5103t-1368)}{(9t^2-15t+7)^2}. \end{aligned}$$

$$\begin{aligned} AL(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} |d_u - d_v| \\ &= |2-3|(18t^2-36t+18) + |2-5|(30) + |2-7|(42t-84) \\ &\quad + |2-12|(36t^2-108t+84) \\ &= 378t^2 - 906t + 528. \end{aligned}$$

$$\begin{aligned} IR1(\mathbb{G}) &= \sum_{u\epsilon V} d_u^3 - \frac{2m}{n}\sum_{u\epsilon V} d_u^2 = F(\mathbb{G}) - \left(\frac{2m}{n}\right) M_1(\mathbb{G}) \\ &= (5562t^2-14226t+20964) - \left(\frac{2(27t^2-51t+24)}{9t^2-15t+7}\right) \\ &\quad (562t^2-14226t+20964) \\ &= \frac{6(3285t^4+102344t^3-361514t^2+401189t-143254)}{9t^2-15t+7}. \end{aligned}$$

$$\begin{aligned} IR2(\mathbb{G}) &= \sqrt{\frac{\sum_{uv\epsilon E(\mathbb{G})} d_u d_v}{m}} - \frac{2m}{n} = \sqrt{\frac{M_2(\mathbb{G})}{m}} - \frac{2m}{n} \\ &= \sqrt{\frac{972t^2-2220t+1248}{27t^2-51t+24}} - \frac{2(27t^2-51t+24)}{9t^2-15t+7}. \end{aligned}$$

$$\begin{aligned} IRF(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} (d_u - d_v)^2 \\ &= (2-3)^2(18t^2-36t+18) + (2-5)^2(30) + (2-7)^2(42t-84) \\ &\quad + (2-12)^2(36t^2-108t+84) \\ &= 3618t^2 - 9786t + 6588. \end{aligned}$$

$$\begin{aligned} IRFW(\mathbb{G}) &= \frac{IRF(\mathbb{G})}{M_2(\mathbb{G})} \\ &= \frac{3618t^2-9786t+6588}{972t^2-2220t+1248}. \end{aligned}$$

□

Theorem 2. *Let $\mathbb{G}$ be the graph of SHN_t. The Irregularity indices are*

1. $IRA(\mathbb{G}) = 9t^2 - 15t + 7 - 12\sqrt{6}t^2 + 30\sqrt{6}t - 6\sqrt{14}t - 20\sqrt{6} - 6\sqrt{10} + 12\sqrt{14}.$
2. $IRB(\mathbb{G}) = 594t^2 - 1314t + 720 - 180\sqrt{6}t^2 + 504\sqrt{6}t - 84\sqrt{14}t - 372\sqrt{6} - 60\sqrt{10} + 168\sqrt{14}.$

3. $IRC(\mathbb{G}) = \frac{1}{3(9t^2-17t+8)(9t^2-15t+7)}(54\sqrt{6}t^4 - 225\sqrt{6}t^3 + 27\sqrt{14}t^3 + 357\sqrt{6}t^2 - 99\sqrt{14}t^2 + 27\sqrt{10}t^2 - 1458t^4 - 255\sqrt{6}t + 111\sqrt{14}t - 45\sqrt{10}t + 5508t^3 + 70\sqrt{6} - 42\sqrt{14} + 21\sqrt{10} - 7794t^2 + 4896t - 1152)$.

Proof.

$$\begin{aligned} IRA(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} (d_u^{-1/2} - d_v^{-1/2})^2 = n - 2R(\mathbb{G}) \\ &= (9t^2 - 15t + 7) - 2(6\sqrt{6}t^2 - 15\sqrt{6}t + 3\sqrt{14}t + 10\sqrt{6} + 3\sqrt{10} - 6\sqrt{14}) \\ &= 9t^2 - 15t + 7 - 12\sqrt{6}t^2 + 30\sqrt{6}t - 6\sqrt{14}t - 20\sqrt{6} - 6\sqrt{10} + 12\sqrt{14}. \end{aligned}$$

$$\begin{aligned} IRB(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} (d_u^{1/2} - d_v^{1/2})^2 = M_1(\mathbb{G}) - 2RR(\mathbb{G}) \\ &= (59t^2 - 1314t + 720) - 2(90\sqrt{6}t^2 - 252\sqrt{6}t + 42\sqrt{14}t + 186\sqrt{6} + 30\sqrt{10} - 84\sqrt{14}) \\ &= 594t^2 - 1314t + 720 - 180\sqrt{6}t^2 + 504\sqrt{6}t - 84\sqrt{14}t - 372\sqrt{6} - 60\sqrt{10} + 168\sqrt{14}. \end{aligned}$$

$$\begin{aligned} IRC(\mathbb{G}) &= \frac{\sum_{uv\epsilon E(\mathbb{G})} \sqrt{d_u d_v}}{m} - \frac{2m}{n} = \frac{RR(\mathbb{G})}{m} - \frac{2m}{n} \\ &= \left(\frac{6\sqrt{6}t^2 - 15\sqrt{6}t + 3\sqrt{14}t + 10\sqrt{6} + 3\sqrt{10} - 6\sqrt{14}}{27t^2 - 51t + 24}\right) \\ &\quad - \left(\frac{2(2t^2 - 51t + 24)}{9t^2 - 15t + 7}\right) \\ &= \frac{1}{3(9t^2 - 17t + 8)(9t^2 - 15t + 7)}(54\sqrt{6}t^4 - 225\sqrt{6}t^3 + 27\sqrt{14}t^3 \\ &\quad + 357\sqrt{6}t^2 - 99\sqrt{14}t^2 + 27\sqrt{10}t^2 - 1458t^4 - 255\sqrt{6}t + 111\sqrt{14}t - 45\sqrt{10}t \\ &\quad + 5508t^3 + 70\sqrt{6} - 42\sqrt{14} + 21\sqrt{10} - 7794t^2 + 4896t - 1152). \end{aligned}$$

□

Theorem 3. *Let $\mathbb{G}$ be the graph of SHN_t. The Irregularity indices are*

1. $IRDIF(\mathbb{G}) = 224.92t^2 - 525.02t + 298.27$.
2. $IRL(\mathbb{G}) = 71.64t^2 - 155.22t + 79.86$.
3. $IRLU(\mathbb{G}) = 189t^2 - 453t + 264$.
4. $IRLF(\mathbb{G}) = 80.64t^2 - 178.86t + 95.04$.
5. $IRLA(\mathbb{G}) = 58.32t^2 - 121.14t + 58.74$.
6. $IRD1(\mathbb{G}) = 98.46t^2 - 207.78t + 104.22$.
7. $IRGA(\mathbb{G}) = 16.20t^2 - 37.44t + 20.88$.

Proof.

$$\begin{aligned} IRDIF(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} \left|\frac{d_u}{d_v} - \frac{d_v}{d_u}\right| \\ &= \left|\frac{2}{3} - \frac{3}{2}\right|(18t^2 - 36t + 18) + \left|\frac{2}{5} - \frac{5}{2}\right|(30) + \left|\frac{2}{7} - \frac{7}{2}\right|(42t - 84) \\ &\quad + \left|\frac{2}{12} - \frac{12}{2}\right|(36t^2 - 108t + 84) \\ &= 224.92t^2 - 525.02t + 298.27. \end{aligned}$$

$$
\begin{aligned}
IRL(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} |lnd_u - lnd_v| \\
&= |ln2 - ln3|(18t^2 - 36t + 18) + |ln2 - ln5|(30) + |ln2 - ln7|(42t - 84) \\
&\quad + |ln2 - ln12|(36t^2 - 108t + 84) \\
&= 71.64t^2 - 155.22t + 79.86.
\end{aligned}
$$

$$
\begin{aligned}
IRLU(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} \frac{|d_u - d_v|}{min(d_u, d_v)} \\
&= \frac{|2-3|}{2}(18t^2 - 36t + 18) + \frac{|2-5|}{2}(30) + \frac{|2-7|}{2}(42t - 84) \\
&\quad + \frac{|2-12|}{2}(36t^2 - 108t + 84) \\
&= 189t^2 - 453t + 264.
\end{aligned}
$$

$$
\begin{aligned}
IRLF(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} \frac{|d_u - d_v|}{\sqrt{d_u.d_v}} \\
&= \frac{|2-3|}{\sqrt{6}}(18t^2 - 36t + 18) + \frac{|2-5|}{\sqrt{10}}(30) + \frac{|2-7|}{\sqrt{14}}(42t - 84) \\
&\quad + \frac{|6-8|}{\sqrt{48}}(36t^2 - 108t + 84) \\
&= 80.64t^2 - 178.86t + 95.04.
\end{aligned}
$$

$$
\begin{aligned}
IRLA(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} 2\frac{|d_u - d_v|}{(d_u + d_v)} \\
&= 2\frac{|2-3|}{5}(18t^2 - 36t + 18) + 2\frac{|2-5|}{7}(30) + 2\frac{|2-7|}{9}(42t - 84) \\
&\quad + 2\frac{|2-12|}{14}(36t^2 - 108t + 84) \\
&= 58.32t^2 - 121.14t + 58.74.
\end{aligned}
$$

$$
\begin{aligned}
IRD1(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} ln\{1 + |d_u - d_v|\} \\
&= ln\{1 + |2-3|\}(18t^2 - 36t + 18) + ln\{1 + |2-5|\}(30) + ln\{1 + |2-7|\}(42t - 84) \\
&\quad + ln\{1 + |2-12|\}(36t^2 - 108t + 84) \\
&= 98.46t^2 - 207.78t + 104.22.
\end{aligned}
$$

$$
\begin{aligned}
IRGA(\mathbb{G}) &= \sum_{uv\epsilon E(\mathbb{G})} ln\left(\frac{d_u + d_v}{2\sqrt{d_u d_v}}\right) \\
&= ln\left(\frac{2+3}{2\sqrt{2\times 3}}\right)(18t^2 - 36t + 18) + ln\left(\frac{2+5}{2\sqrt{2\times 5}}\right)(30) + ln\left(\frac{2+7}{2\sqrt{2\times 7}}\right)(42t - 84) \\
&\quad + ln\left(\frac{2+12}{2\sqrt{2\times 12}}\right)(36t^2 - 108t + 84) \\
&= 16.20t^2 - 37.44t + 20.88.
\end{aligned}
$$

□

3. Graphical Representation and discussion of results

This section is about the graphical representation of SHN_t. We plot our results of sixteen irregularity indices for SHN_t.

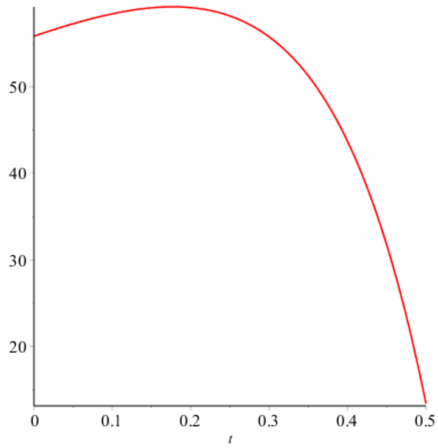

Figure 3. Dendrimer Architecture

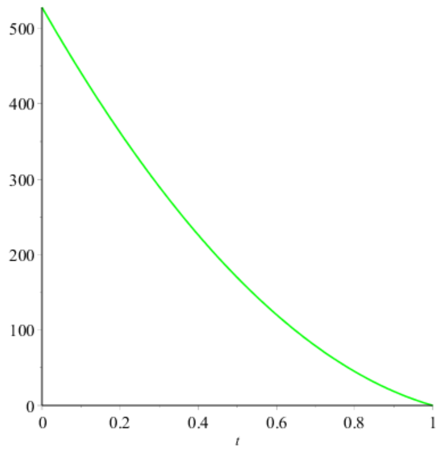

Figure 4. Dendrimer Architecture

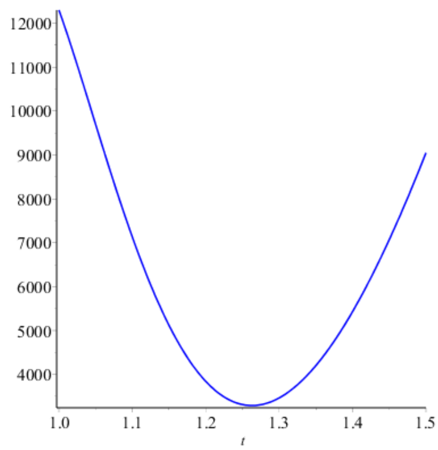

Figure 5. Dendrimer Architecture

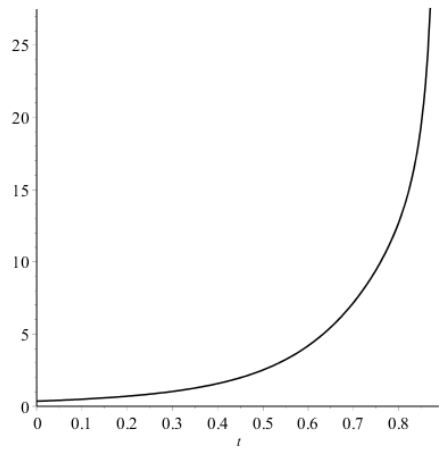

Figure 6. Dendrimer Architecture

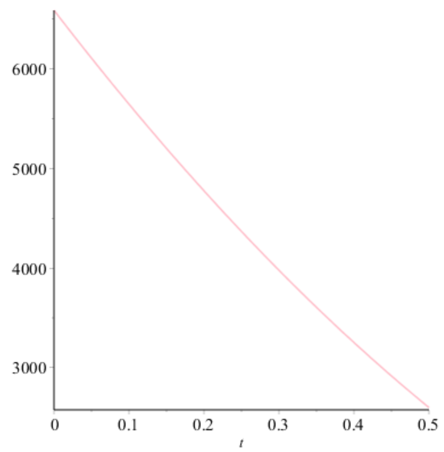

Figure 7. Dendrimer Architecture

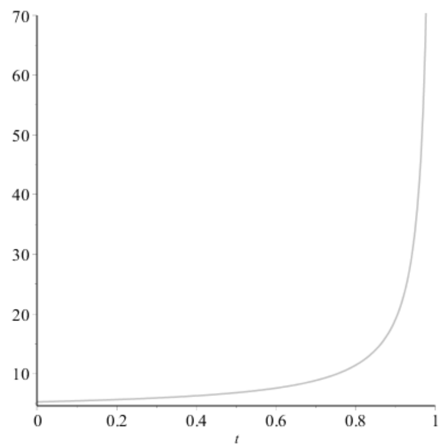

Figure 8. Dendrimer Architecture

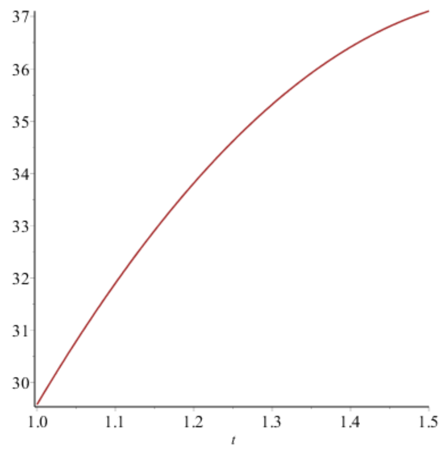

Figure 9. Dendrimer Architecture

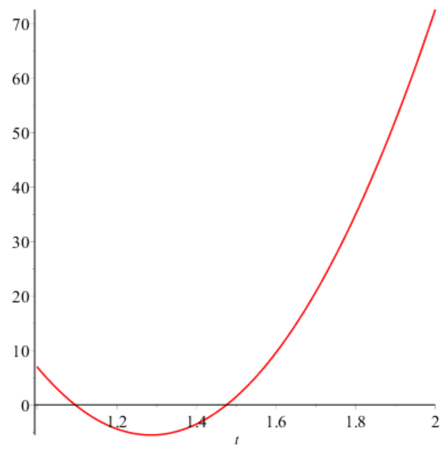

Figure 10. Dendrimer Architecture

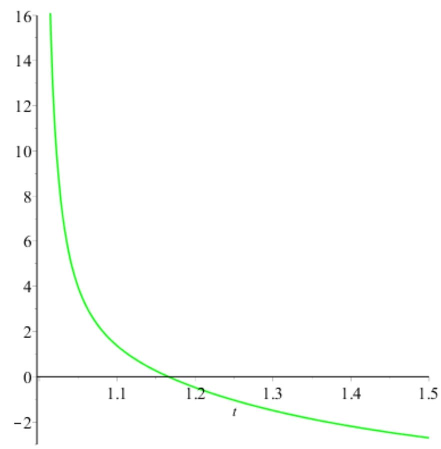

Figure 11. Dendrimer Architecture

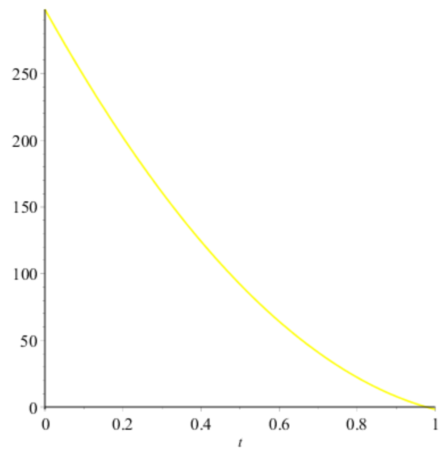

Figure 12. Dendrimer Architecture

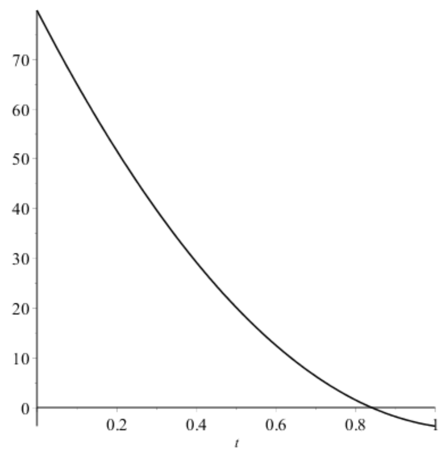

Figure 13. Dendrimer Architecture

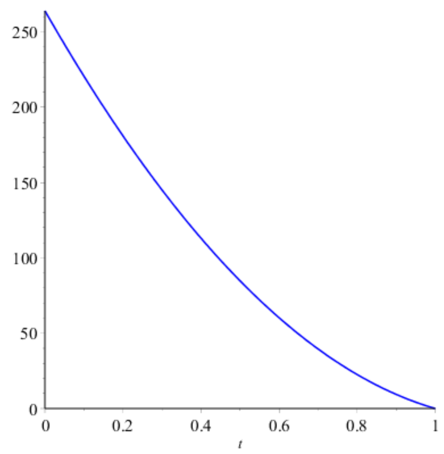

Figure 14. Dendrimer Architecture

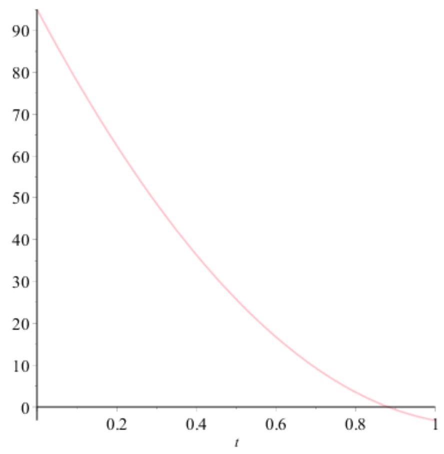

Figure 15. Dendrimer Architecture

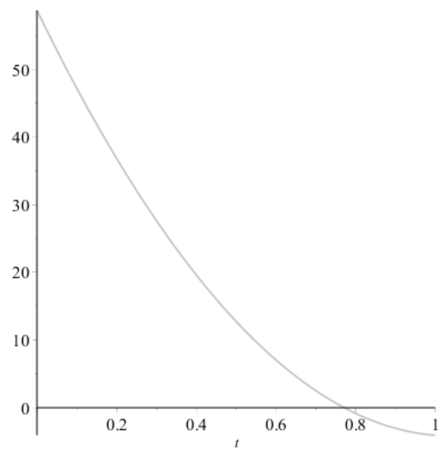

Figure 16. Dendrimer Architecture

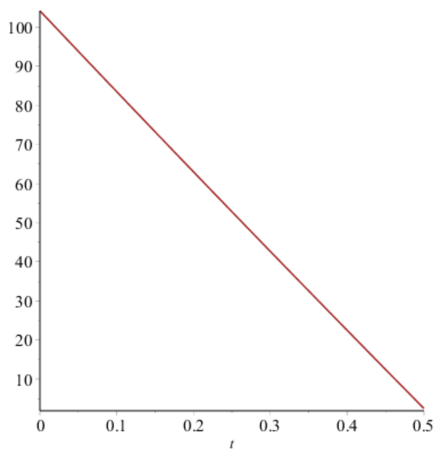

Figure 17. Dendrimer Architecture

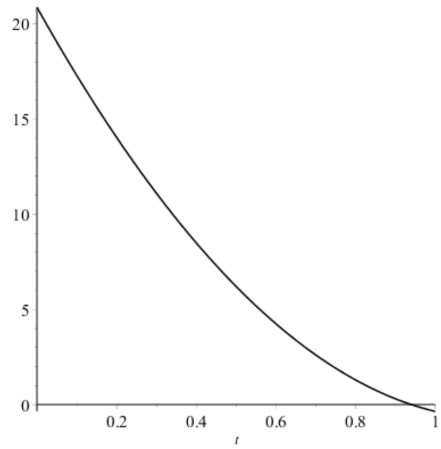

Figure 18. Dendrimer Architecture

4. Conclusion

A topological index is a number associated with a chemical network that links the physio-chemical properties of certain chemical compounds. The connection between the architecture and various bio capabilities, electrochemical stability, and bio activities depends on these graph-matching mathematical values. The summary of the topological index on chemical structure and the associated clinical, chemical, biological, and medicinal properties of drugs may be examined by medical science. In this article, we compute the sixteen irregularity indices SHN_t. In the last section, we give the graphical representation of SHN_t.

References

[1] Farahani, M. R. (2015) computing the hyper-Zagreb index of hexagonal nanotubes. *Department of Applied Mathematics (IUST), Narmak, Tehran, Iran. 2* 1, 16-18.

[2] Chen, M. S., & Shin, K. G. (1990) Kandlur, D. D. Addressing, routing, and broadcasting in hexagonal mesh multiprocessors. *IEEE Trans. Comput. 39,* 10-18.

[3] Brückler, F. M., DoŽlic, T., Graovac, A., & Gutman, I. (2011). On a class of distance-based molecular structure descriptors. *Chemical physics letters, 503*(4-6), 336-338.

[4] Gonzalez-Diaz, H., Vilar, S., Santana, L., & Uriarte, E. (2007). Medicinal chemistry and bioinformatics-current trends in drugs discovery with networks topological indices. *Current Topics in Medicinal Chemistry, 7*(10), 1015-1029.

[5] Hosoya, H., Hosoi, K., & Gutman, I. (1975). A topological index for the totalp-electron energy. *Theoretica chimica acta, 38*(1),

[6] Amin, S., Rehman Virk, A. U., Rehman, M. A., & Shah, N. A. (2021). Analysis of dendrimer generation by Sombor indices. *Journal of Chemistry*, 2021.

[7] Gao, W., Younas, M., Farooq, A., Virk, A. U. R., & Nazeer, W. (2018). Some reverse degree-based topological indices and polynomials of dendrimers. *Mathematics, 6*(10), 214.

[8] Dobrynin, A. A., Entringer, R., & Gutman, I. (2001). Wiener index of trees: theory and applications. *Acta Applicandae Mathematica, 66* (3), 211-249.

[9] Gutman, I., & Polansky, O. E. (2012). *Mathematical concepts in organic chemistry.* Springer Science & Business Media.

[10] Caporossi, G., Gutman, I., Hansen, P., & Pavlovic, L. (2003). Graphs with maximum connectivity index. *Computational Biology and Chemistry, 27*(1), 85-90.

[11] Li, X., & Gutman, I. (2006). Mathematical chemistry monographs no. 1. *University of Kragujevac, Kragujevac, Macedonia.*

[12] Li, X., & Shi, Y. (2008). A survey on the Randić index. MATCH Commun. *Math. Comput. Chem, 59*(1), 127-156.

[13] Nikolić, S., Kovačević, G., Miličević, A., & Trinajstic, N. (2003). The Zagreb indices 30 years after. *Croatica chemica acta,76*(2), 113-124.

[14] Gutman, I., & Das, K. C. (2004). The first Zagreb index 30 years after. *MATCH Commun. Math. Comput. Chem, 50*(1), 83-92.

[15] Virk. A. R., Rehman, M. A & Nazeer, W. (2019). New definition of atomic bond connectivity index to overcome deficiency of structure sensitivity and abruptness in existing definition. *Sci Inquiry Rev, 3*(4), 1-20.

[16] Shao, Z., Virk, A. R., Javed, M. S., Rehman, M. A. & Farahani, M. R. (2019).Degree based graph invariants for the molecular graph of Bismuth Tri-Iodide, *Eng. Appl. Sci. Lett.,2*(1),01-11.

[17] Virk, A. R., Jhangeer, M. N., & Rehman, M. A. (2018). Reverse Zagreb and reverse hyper-Zagreb indices for silicon carbide $Si_2C_3 - I[r,s]$ and $Si_2C_3 - II[r,s]$. *Eng. Appl. Sci. Lett.*,*1*(2), 37-48
[18] Réti, T., Sharafdini, R., Dregelyi-Kiss, A., & Haghbin, H. (2018). Graph irregularity indices used as molecular descriptors in QSPR studies. *MATCH Commun. Math. Comput. Chem*, *79*, 509-524.