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Salahaddin University-Erbil

The Sombor Coindex of the Conjugacy Class Graph of Some Finite Groups

Research Project

Submitted to the department of (Mathematics) in partial fulfillment of the requirements for the degree of B.Sc. in (MATHEMATICS)

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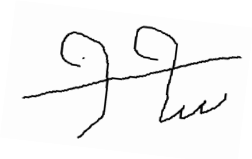
Certification of the Supervisors

I certify that this work was prepared under my supervision at the Department of Mathematics / College of Education / Salahaddin University-Erbil in partial fulfillment of the requirements for the degree of Bachelor of philosophy of Science in Mathematics.

Signature: 

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I acknowledge our deep sense of gratitude to my loving parents for being a constant

Source of inspiration and motivation.

ABSTRACT

This project is concerned with a recently introduced graph (Γ) invariant, namely the Sombor coindex is defined by $SOC(\Gamma) = \sum_{u,v \notin (\Gamma)} \sqrt{d\Gamma(u)^2 + d\Gamma(v)^2}$, where $d\Gamma(u)$ is the degree of vertex u in Γ. We determine the Sombor coindex of conjugacy class graph of some finite groups such as D_{2n}, SD_{8n} and T_{4n}.

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INTRODUCTION

Graph Theory is a well-known area of discrete mathematics which deals with the study of graphs. A graph may be considered as a mathematical structure that is used for modelling the pairwise relations between objects. In (Bertram, Herzong and Mann 1990), Bertram introduced a new graph related to the conjugacy class. The vertices of this graph are non-central conjugacy classes Suppose G is a finite group and Γ denotes a simple undirected graph. A conjugacy class is an equivalence relation, in which the group is partitioned into disjoint equivalence classes. The conjugate graph is a graph whose vertices are non-central elements of G in which two vertices are adjacent if they are conjugate. The conjugacy class graph is a graph whose vertices are non-central conjugacy classes of a group G in which two vertices are connected if their cardinalities are not coprime.

The study of the mathematical aspects of the degree-based graph invariants (also known as topological indices) is considered to be one of the very active research areas within the field of chemical graph theory. Recently, the mathematical chemist Ivan Gutman, one of the pioneers of chemical graph theory, proposed a geometric approach to interpret degree-based graph invariants and based on this approach, he devised three new graph invariants; namely the Sombor coindex, the reduced Sombor coindex and the average Sombor coindex. The Sombor coindex, being the simplest one among the aforementioned three invariants, has attracted a significant attention from researchers within a very short time (e.g[2,7,8,9,15]) (Igor Milovanovic 2021). The Sombor coindex has received a lot of attention within mathematics and chemistry. For example, the chemical applicability of the Sombor coindex, especially the predictive and discriminative potentials.

This project consists of four chapters. In the first chapter, we give some necessary background about groups and graphs. In the second chapter, we find the sombor coindex of conjugacy class graph of dihedral group D_{2n}. In the third chapter, we find the sombor coindex of conjugacy class graph of quasi dihedral group SD_{8n}. In the fourth chapter, we find the sombor coindex of conjugacy class graph of dicyclic group T_{4n}.

CHAPTER ONE

Backgrounds

Definition1.1 (Dummit & Foote , 2003): A group $(G,*)$ is a set G, together with a binary operation $*$on G, such that the following axioms are satisfied:

I-The binary operation is associative.

II-There is an element e in G such that $x * e = e * x = x$ for all $x \in$ G, (the element e is an identity element for $*$ on G).

III- For each a in G, there is an element a^{-1} in G with the property that $a * a^{-1} = a^{-1} * a = e$ (the element a^{-1} is an inverse of a with respect to $*$).

Definition1.2 (JAMES & LIEBECK, 2001): Let $x, y \in G$. We say that x is a conjugate to y in G if $y = g^{-1} * x * g \; for \; g \in G$.

Definition1.3 (JAMES & LIEBECK, 2001): Let $G=D_{2n}$, the dihedral group of order $2n$. Then, $G=\langle r, s : r^n = s^2 = 1, s^{-1}rs = r^{-1} \rangle$

Definition1.4 (ALI & REZA, 2020): Let $G=SD_{8n}$, the quasi_dihedral group of order $8n$. Then, $G=\langle r, s: r^{4n} = s^2 = 1, srs = r^{2n-1} \rangle$

Definition1.5 (JAMES & LIEBECK, 2001): Let G=T_{4n}, the dicyclic group of order $4n$. Then, $G=\langle r, s : r^{2n} = 1, r^n = s^2, s^{-1}r\,s = r^{-1} \rangle$

Definition1.6 (Bogopolski, 2008): A group G is finite if G contains only finitely many elements

Definition1.7 (Dummit & Foote , 2003): If $a, b \in \mathbb{Z} - \{ 0 \}$, there exist a unique positive integer d, called the greatest common divisor of a and b, satisfying:

(a) d | a and d | b (so d is the common divisor of a and b), and

(b) If e | a and e | b, then e | d (so d is the greatest such divisor).

Definition1.8 (Dummit & Foote , 2003): The center of a group $(G,*)$, denoted by $cent(G)$ or $Z(G)$ is the set $cent(G) = \{c \in G : c * x = x * c \; for\ all\ x \in G\}$.

Definition1.9 (DEO, 1974): A Graph $\Gamma = (V, E)$ consists of a set of objects $V = \{v1, v2, \ldots\}$ called vertices, and another set $E = \{e1, e2, \ldots\}$, whose elements are called edges, such that each edge e_k is identified with an unordered pair (v_i , v_j) of vertices

Definition1.10 (Ray, 2013): A Complete graph is a simple graph in which pair of distinct vertices is joined by an edge.

Definition1.11 (Chinglensana & Mawiong, 2021): Let Γ be a graph. Then the *Sombor coindex* of Γ, denoted by $SOC(\Gamma)$, is defined by

$$SOC(\Gamma) = \sum_{u,v \notin (\Gamma)} \sqrt{d\Gamma(u)^2 + d\,\Gamma(v)^2}$$

Theorem1.12 (JAMES & LIEBECK, 2001): The dihedral group D_{2n} (n odd) has precisely $\frac{1}{2}\,(n+3)$ conjugacy classes:

$$\{1\}, \{r, r^{-1,}\}, \ldots, \left\{r^{(n-1)/2}, r^{-(n-1)/2}\right\}, \{s, rs, \ldots, r^{n-1}b\}.$$

Theorem1.13 (JAMES & LIEBECK, 2001): The dihedral group D_{2n} (n even, n=2m) has precisely $(m+3)$ conjugacy classes:$\{1\}, \{r^m\}, \{r, r^{-1}\}, \ldots, \{r^{m-1}, r^{-m+1}\}$.

CHAPTER TWO

The Sombor Coindex of the Conjugacy Class Graph of the dihedral group D_{2n}

In this chapter we compute the Sombor coindex of conjugacy class graph of dihedral group D_{2n} .

Recall that the dihedral group D_{2n} of order 2n is defined by the presentation $\boldsymbol{D_{2n}} = \langle r, s{:}r^n = s^2 = 1, s^{-1}rs = r^{-1}\rangle$ and

$$Z(D_{2n}) = \begin{cases} 1 & if \quad n \; is \; odd \\ \left\{1, r^{\frac{n}{2}}\right\} & if \; n \; is \; even \end{cases}$$

Theorem2.1: Let Γ=D_{2n} be a conjugacy class graph of D_{2n}. If n is odd. Then, Γ= $K_{\frac{(n-1)}{2}} \cup K_1$.

Proof: By Theorem1.12, D_{2n} has $\frac{n+1}{2}$ noncentral conjugacy classes such that $\frac{n-1}{2}$ conjugacy classes have size 2 and only one conjugacy class is of size $\boldsymbol{n}$**.** Then $\Gamma = K_{\frac{n-1}{2}} \cup K_1$.

Theorem2.2: Let $\Gamma = D_{2n}$ be a conjugacy class graph of D_{2n}. If n is odd, then,

$$SOC(\Gamma) = \frac{(n-1)(n-3)}{4}$$

Proof: By Theorem 2.1, Γ= $K_{\frac{(n-1)}{2}} \cup K_1$. So, there are $\frac{n-1}{2}$ off-edges each has one end-vertex of degree $\frac{n-3}{2}$ and the other end-vertex of degree zero. Thus,

$$SOC(\Gamma) = \frac{n-1}{2}\sqrt{\left(\frac{n-3}{2}\right)^2 + 0^2}$$

$$= \frac{(n-1)(n-3)}{4}$$

Example2.3: If $n = 11$, then $D_{2.11}$

$= \{1, r, r^2, r^3, r^4, r^5, r^6, r^7, r^8, r^9, r^{10}, s, sr, sr^2, sr^3, sr^4, sr^5, sr^6, sr^7, sr^8, sr^9, sr^{10}\}$

$C_1 = \{r, r^{10}\}$ $C_2 = \{r^2, r^9\}$ $C_3 = \{r^3, r^8\}$ $C_4 = \{r^4, r^7\}$ $C_5 = \{r^5, r^6\}$

$C_6 = \{s, sr, sr^2, sr^3, sr^4, sr^5, sr^6, sr^7, sr^8, sr^9, sr^{10}\}$

Solution: $SOC(D_{2.11}) = \frac{(n-1)(n-3)}{4}$

$= \frac{(\mathbf{11-1})(\mathbf{11-3})}{\mathbf{4}}$

$= \frac{(\mathbf{10})(\mathbf{8})}{\mathbf{4}}$

$= 20$

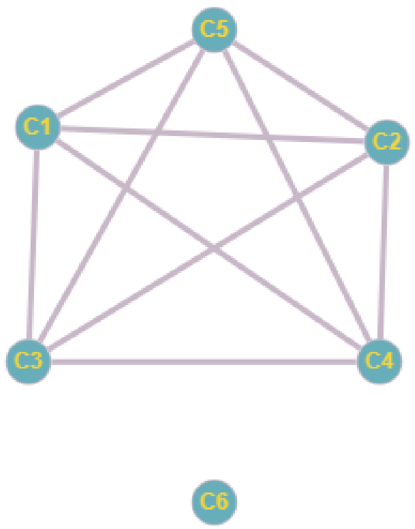

Figure 1:conjugacy class graph of $D_{2.11}$

Theorem2.4: Let $\Gamma = \Gamma(D_{2n})$ be a conjugacy class graph of D_{2n}. If $n = 2m$, then

$$\Gamma = \begin{cases} K_{m+1} & if\ 2|m \\ K_{m-1} \cup K_2 & if\ 2 \nmid m \end{cases}$$

Proof: There are two cases for m to consider**.**

Case1: If $n = 2m$, m is even has $(m+1)$ noncentral conjugacy classes such that $(m-1)$ conjugacy classes have size and only two conjugacy class has size m. Then $\Gamma = K_{m+1}$.

Case2: If $n = 2m$, m is odd, there are $(m+1)$ noncentral conjugacy classes of D_{2n} for which $m-1$ classes size 2 and two classes have size m.therefore,

$\Gamma = K_{m-1} \cup K_2$.

Theorem2.5: Let Γ=Γ(D_{2n}) be a conjugacy class graph of D_{2n}. If $n=2m$, then

$$\text{SOC }(\Gamma) = \begin{cases} 0 & if \quad 2|m \\ 2(m-2)\sqrt{m^2-4m+5} & if \quad 2 \nmid m \end{cases}$$

Proof: There are two cases for m to consider

Case1: If 2|m, then $\Gamma = K_{m+1}$ and then $SOC\ (\Gamma) = 0$

Case2: If $2 \nmid m$, then there are $2(m-1)$ off_edeges each has one end_vertex of degree $m-2$ and the other end_vertex one. Thus,

$$SOC(\Gamma) = 2(m-1)\sqrt{1^2 + (m-2)^2}$$

$$= 2(m-1)\sqrt{1 + m^2 - 4m + 4}$$

$$= 2(m-1)\sqrt{m^2 - 4m + 5}$$

Example2.6: If n=8, then
$D_{2\cdot 8}$=$\{1, r, r^2, r^3, r^4, r^5, r^6, r^7, s, sr, sr^2, sr^3 sr^4, sr^5, sr^6, sr^7\}$.

c_1=$\{r, r^7\}$ c_2=$\{r^2, r^6\}$ c_3= $\{r^3, r^5\}$ $c_4 = \{s, sr^2, sr^4, sr^6\}$

$c_5 = \{sr, sr^3, sr^5, sr^7\}$

Solution: $SOC(D_{2.8}) = 0$

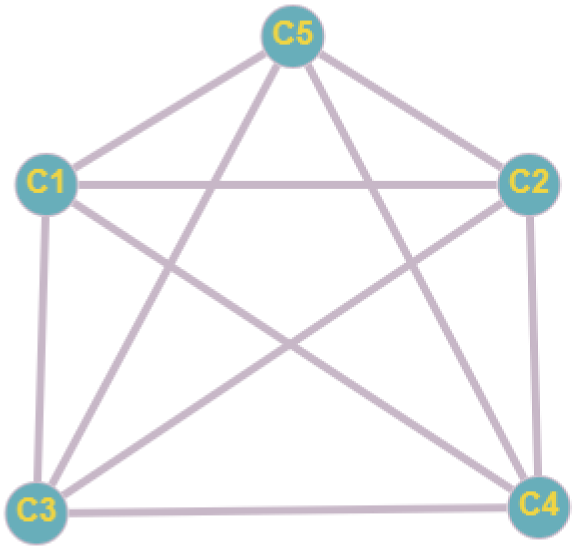

Figure 2:conjugacy class graph of $D_{2.8}$

Example2.7: If $n = 10$, then

$D_{2\cdot10}$=$\{1, r, r^2, r^3, r^4, r^5, r^6, r^7, r^8, r^9, s, sr, sr^2, sr^3, sr^4, sr^5, sr^6, sr^7, sr^8, sr^9\}$

c_1=$\{r, r^9\}$ c_2=$\{r^2, r^8\}$ $c_3 = \{r^3, r^7\}$ $c_4 = \{r^4, r^6\}$

c_5=$\{sr, sr^3, sr^5, sr^7, sr^9\}$ c_6=$\{s,\ sr^2, sr^4, sr^6, sr^8\}$

Solution: $SOC(\Gamma) = 2(m-1)\sqrt{m^2 - 4m + 5}$

$$SOC(D_{2\cdot10}) = 2(5-1)\sqrt{5^2 - 4(5) + 5}$$

$$= 2(4)\sqrt{25 - 20 + 5}$$

$$= 8\sqrt{10}$$

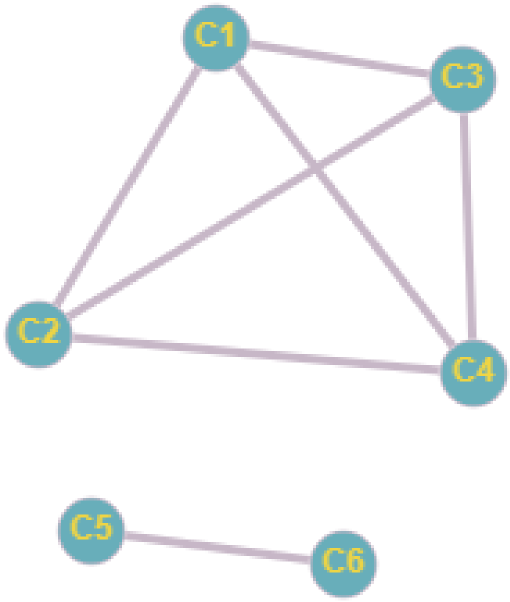

Figure 3: conjugacy class graph of $D_{2.10}$

CHAPTER THREE

The Sombor Coindex of the Conjugacy Class Graph of the quasi_ dihedral group SD_{8n}

In this chapter we compute the Sombor coindex of conjugacy class graph of quasi-dihedral group SD_{8n} .

Recall that the quasi-dihedral group SD_{8n} of order $8n$ is defined by the presentation $SD_{8n} = \langle r, s: r^{4n} = s^2 = 1, srs = r^{2n-1} \rangle$ and

$$Z(SD_{8n}) = \begin{cases} \{1, r^{2n}\} & if \quad n \ is \ even \\ \{1, r^n, r^{2n}, r^{3n}\} & if \quad n \ is \ odd \end{cases}$$

Theorem3.1: Let $\Gamma=\Gamma(SD_{8n})$ be a conjugacy class graph of SD_{8n}. Then

$$\Gamma= \begin{cases} K_{2n+1} & if \quad n \ is \ even \\ K_{2n-2} \cup K_4 & if \quad n \ is \ odd \end{cases}$$

Proof: By (ALI & REZA, 2020), there are two case to consider.

Case1: When n is even. There are $(2n - 1)$ noncentral conjugacy class of size 2 and two noncentral conjugacy class of size $2n$. It is clear that the size of any two conjugacy classes are not coprime. Thus, $\Gamma = K_{2n+1}$.

Case2: When n is odd. There are $(2n - 2)$ noncentral conjugacy class of size 2 and four noncentral conjugacy class of size n. Thus, $\Gamma = K_{2n-2} \cup K_4$.

Theorem 3.2: Let $\Gamma=\Gamma(SD_{8n})$ be a conjugacy class graph of SD_{8n}.Then

$$|E(\Gamma)|= \begin{cases} n(2n+1) & if \quad n \ is \ even \\ 2n^2 - 5n + 9 & if \quad n \ is \ odd \end{cases}$$

Proof: It is a straightforward from Theorem 3.1.

Theorem3.3: Let $\Gamma=\Gamma(SD_{8n})$ be a conjugacy class graph of SD_{8n}.Then

$$SOC(\Gamma) = \begin{cases} 0 & if \quad n \ is\ even \\ 8(n-1)\sqrt{4n^2 - 12n + 18} & if \quad n\ is\ odd \end{cases}$$

Proof: There are two cases to consider

Case1: When n is even, then by Theorem3.1, $SOC(\Gamma) = 0$.

Case2: When n is odd, then by Theorem3.2 there are $4(2n-2)$ off-edges with one end-vertex of degree three and the other end-vertex of degree $2n-3$ then, the

$$SOC(\Gamma) = 4(2n-2)\sqrt{3^2 + (2n-3)^2}$$

$$=4(2n-2)\sqrt{9 + 4n^2 - 12n + 9}$$

$$= 8(n-1)\sqrt{4n^2 - 12n + 18}.$$

Example3.4: If $n = 4$, then. $SD_{8.4} =$
$\{1, r, r^2, r^3, r^4, r^5, r^6, r^7, r^8, r^9, r^{10}, r^{11}, r^{12}, r^{13}, r^{14}, r^{15}, s, sr, sr^2, sr^3, sr^4, sr^5, sr^6,$
$sr^7, sr^8, sr^9, sr^{10}, sr^{11}, sr^{12}, sr^{13}, sr^{14}, sr^{15}\}$.
$C_1 = \{r, r^{15}\}$ $C_2 = \{r^2, r^{14}\}$ $C_3 = \{r^3, r^{13}\}$ $C_4 = \{r^4, r^{12}\}$ $C_5 = \{r^5, r^{11}\}$
$C_6 = \{r^6, r^{10}\}$ $C_7 = \{r^7, r^9\}$ $C_8 = \{s, sr^2, sr^4, sr^6, sr^8, sr^{10}, sr^{12}, sr^{14}\}$
$C_9 = \{sr, sr^3, sr^5, sr^7, sr^9, sr^{11}, sr^{13}, sr^{15}\}$
Solution: $SOC(SD_{8.4}) = 0$

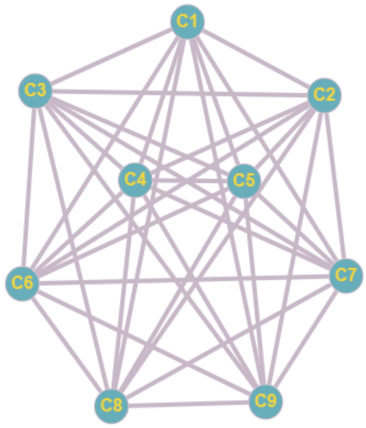

Figure 4: conjugacy class graph of $SD_{8.4}$

Example3.5: If $n = 5$, then. $SD_{8.5} = \{1, r, r^2, r^3, r^4, r^5, r^6, r^7, r^8, r^9, r^{10}, r^{11}, r^{12}, r^{13}, r^{14}, r^{15}, r^{16}, r^{17}, r^{18}, r^{19}, s, sr, sr^2, sr^3, sr^4, sr^5, sr^6, sr^7, sr^8, sr^9, sr^{10}, sr^{11}, sr^{12}, sr^{13}, sr^{14}, sr^{15}, sr^{16}, sr^{17}, sr^{18}, sr^{19}\}$

$C_1 = \{r, r^{19}\}$ $C_2 = \{r^2, r^{18}\}$ $C_3 = \{r^3, r^{17}\}$ $C_4 = \{r^4, r^{16}\}$ $C_5 = \{r^6, r^{14}\}$

$C_6 = \{r^7, r^{13}\}$ $C_7 = \{r^8, r^{12}\}$ $C_8 = \{r^9, r^{11}\}$ $C_9 = \{s, sr^2, sr^4, sr^6, sr^8,\}$

$C_{10} = \{sr^{10}, sr^{12}, sr^{14}, sr^{16}, sr^{18}\}$ $C_{11} = \{sr, sr^3, sr^5, sr^7, sr^9,\}$

$C_{12} = \{sr^{11}, sr^{13}, sr^{15}, sr^{17}, sr^{19}\}$

Solution: $SOC(SD_{8.5}) = 4(2n-2)\sqrt{3^2 + (2n-3)^2}$

$$= 4(2(5)-2)\sqrt{3^2 + (2(5)-3)^2}$$

$$= 4(8)\sqrt{9+49}$$

$$= 32\sqrt{58}$$

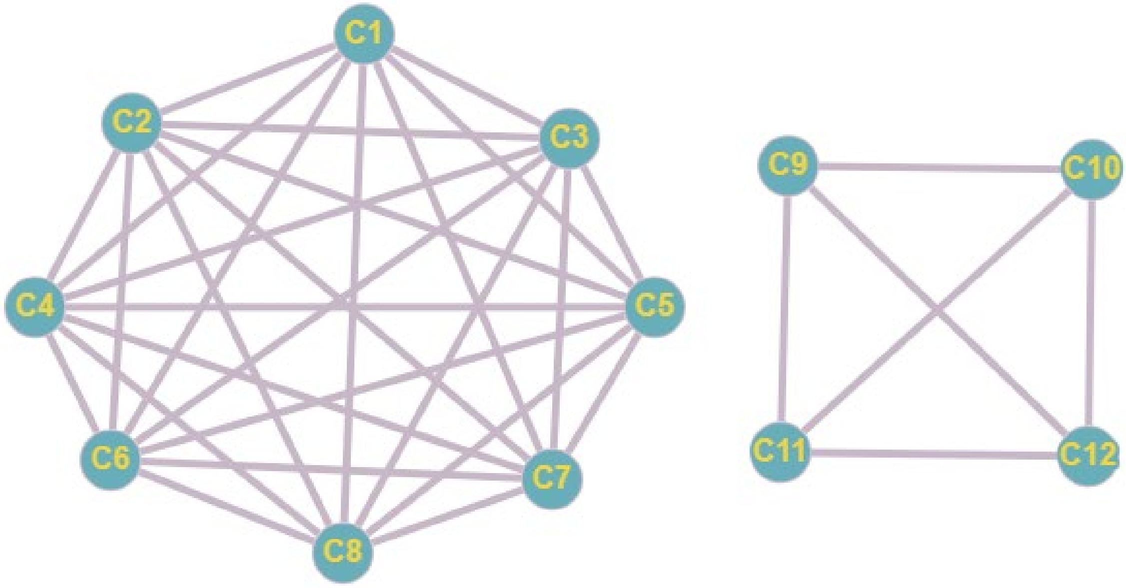

Figure 5: conjugacy class graph of $SD_{8.5}$

CHAPTER FOUR

The Sombor Coindex of the Conjugacy Class Graph of the dicyclic group T_{4n}

In this chapter we compute the Sombor coindex of conjugacy class graph of dicyclic group T_{4n} .

Recall that the dicyclic group T_{4n} of order $4n$ is defined by the presentation

T_{4n}=$\langle r, s : r^{2n} = 1, r^n = s^2, s^{-1}r\ s\ = r^{-1}\rangle$ and $Z(T_{4n}) = \{1, r^n\}$.

Theorem4.1: Let $\Gamma = \Gamma(T_{4n})$ be a conjugacy class graph of T_{4n}. Then

$$\Gamma = \begin{cases} K_{n+1} & if \quad n\ is\ even \\ K_{n-1} \cup K_2 & if \quad n\ is\ odd \end{cases}$$

Proof: By (JAMES & LIEBECK, 2001), there are two case to consider.

Case1: When n is even. There are $(n-1)$ noncentral conjugacy class of size 2 and two noncentral conjugacy class of size n. Then the cardinality of any pair of these classes are not coprime. Thus, $\Gamma = K_{n+1}$.

Case2: When n is odd. There are $(n-1)$ noncentral conjugacy class of size 2 and two noncentral conjugacy classes of size n. Thus, $\Gamma = K_{n-1} \cup K_2$.

Theorem4.2: Let $\Gamma = \Gamma(T_{4n})$ be a conjugacy class graph of T_{4n}. Then

$$SOC(\Gamma) = \begin{cases} 0 & if \quad n\ is\ even \\ 2(n-1)\sqrt{n^2-4n+5} & if \quad n\ is\ odd \end{cases}$$

Proof: There are two case to consider

Case1: When n is even, then by Theorem4.1, $SOC(\Gamma) = 0$.

Case2: When n is odd, there are $2(n-1)$ off-edges with one end-vertex of degree one and the other end-vertex of degree$(n-2)$. Then, the

$$SOC(\Gamma) = 2(n-1)\sqrt{1^2 + (n-2)^2}$$

$$= 2(n-1)\sqrt{1^2 + n^2 - 4n + 4}$$

$$= 2(n-1)\sqrt{n^2 - 4n + 5}$$

Example4.3: If $n = 6$, then. $T_{4.6} =$
$\{1, r, r^2, r^3, r^4, r^5, r^6, r^7, r^8, r^9, r^{10}, r^{11}, s, sr, sr^2, sr^3, sr^4, sr^5, sr^6, sr^7, sr^8, sr^9, sr^{10}, sr^{11}\}$.

$C_1 = \{r, r^{11}\}$ $C_2 = \{r^2, r^{10}\}$ $C_3 = \{r^3, r^9\}$ $C_4 = \{r^4, r^8\}$ $C_5 = \{r^5, r^7\}$

$C_6 = \{s, sr^2, sr^4, sr^6, sr^8, sr^{10}\}$ $C_7 = \{sr, sr^3, sr^5, sr^7, sr^9, sr^{11}\}$

Solution: $SOC(T_{4.6}) = 0$

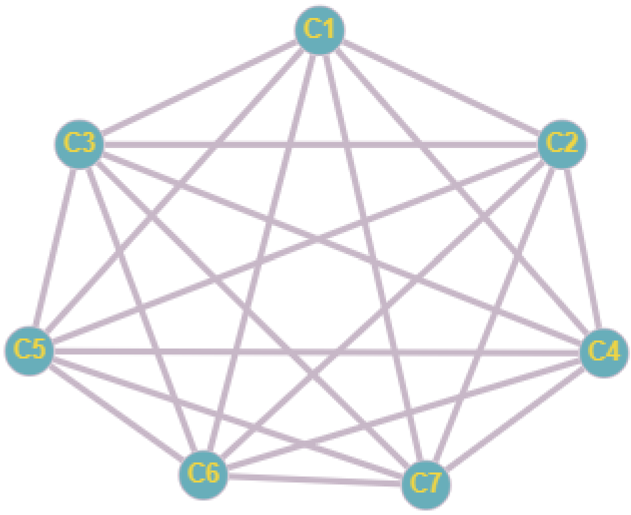

Figure 6: conjugacy class graph of $T_{4.6}$

Example4.4: If $n = 7$, then. $T_{4.7} =$
$\{1, r, r^2, r^3, r^4, r^5, r^6, r^7, r^8, r^9, r^{10}, r^{11}, r^{12}, r^{13}, s, sr, sr^2, sr^3, sr^4, sr^5, sr^6, sr^7, sr^8, sr^9, sr^{10}, sr^{11}, sr^{12}, sr^{13}\}$

$C_1 = \{r, r^{13}\}$ $C_2 = \{r^2, r^{12}\}$ $C_3 = \{r^3, r^{11}\}$ $C_4 = \{r^4, r^{10}\}$ $C_5 = \{r^5, r^9\}$

$C_6 = \{r^6, r^8\}$ $C_7 = \{s, sr^2, sr^4, sr^6, sr^8, sr^{10}, sr^{12},\}$

$C_8 = \{sr, sr^3, sr^5, sr^7, sr^9, sr^{11}, sr^{13},\}$

Solution: $SOC(T_{4.7}) = 2(n-1)\sqrt{n^2-4n+5}$

$$= 2(7-1)\sqrt{7^2-4(7)+5}$$

$$= 2(6)\sqrt{49-28+5}$$

$$= 12\sqrt{26}$$

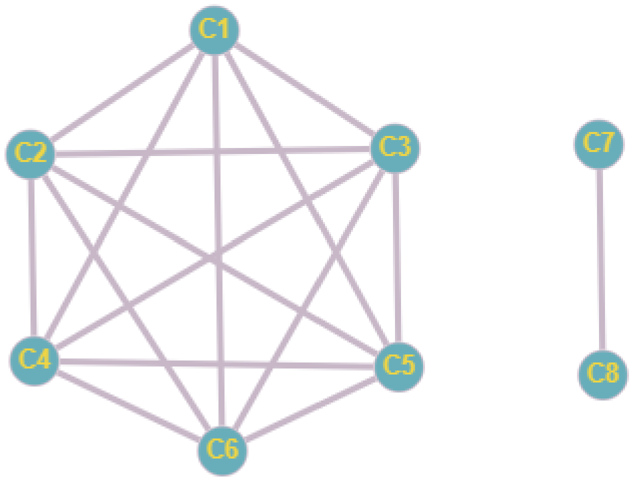

Figure 7: conjugacy class graph of $T_{4.7}$

REFERENCE

ALI, M. S. & REZA, A. A., 2020. COMMUTING CONJUGACY CLASS GRAPH OF FINITE CA-GROUPS. *Khayyam Journal of Mathematics ,* 6(1), pp. 108-118.

ASHRAFI, M. A. S. A. A. R., 2020. C0MMUTING CONJUGACY CLASS GRAPH OF FINITE CA-GROUPS. *Khayyam Journal of Mathematics ,* 6(1), pp. 108-118.

Bogopolski, O. V., 2008. s.l.:s.n.

Chinglensana, P. & Mawiong, S., 2021. On Sombor Coindex of graphs.

DEO, N., 1974. *Graph theory with applications to enginering and computer science.* s.l.:s.n.

Dummit, D. S. & Foote , R. M., 2003. *Abstract ALgebra.* 3rd Edition ed. s.l.:WILEY.

Foote, D. S. D. a. R. M. .., 2003. *Abstract Algebra.* third ed. s.l.:s.n.

JAMES, G. & LIEBECK, M., 2001. *REPRESENTATIONS AND CHARACTERS OF GROUPS.* Second Edition ed. Cambridge University Press : Virtual Publishing.

LIEBECK, G. J. A. M., 2001. *REPRESENTATIONS AND CHARACTERS OF GROUPS.* Second ed. s.l.:s.n.

LIEBECK, G. J. A. M., n.d. *REPRESENTATIONS AND CHARACTERS OF GROUPS.* Second Edition ed. s.l.:s.n.

Mawiong, P. C. A. S., 2021. Sombor Coindex of graphs.

Ray, S. S., 2013. *Graph Theory With Algorithms and its Applications.* first ed. India : Springer.

پوختە

ئەم پڕۆژەیە پەیوەندی بە نەگۆڕێکی گرافیەوە هەیە کەبەم دواییە سەلمێندرا،ئەویش
کە بەم شێوەیە پێناسە دەکرێت ,SomborCoindex

$SOC(\Gamma) = \sum_{uv \notin (\Gamma)} \sqrt{d\Gamma(u)^2 + d\Gamma(v)^2}$ کە

ئێمە لێرەدا $d_r(u)$ is the degree of vertex u in Γ

The Sombor Coindex of conjugacy class graph of some finite groups

دیاری دەکەین $(\mathrm{T}_{4\mathrm{n}}, \mathrm{SD}_{8\mathrm{n}}, \mathrm{D}_{2\mathrm{n}})$

الخلاصة

الذي تم أدخاله مؤخرا ، وهو مؤشر Γ يهتم هذا المشرع بالرسم البياتى Sombor Coindex Sombor

يتم تعريفه على أنة

$d_r(u)$, حيث $SOC(\Gamma) = \sum_{uv \notin (\Gamma)} \sqrt{d\Gamma(u)^2 + d\Gamma(v)^2}$

يكون درجة الرأس فيΓتحدد مؤشر

The Sombor Coindex of conjugacy class graph of some finite groups

$(T_{4n}, SD_{8n}, D_{2n})$