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ZERO-CONSTANT REVERSE MAGIC GRAPHOIDAL GRAPHS

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ABSTRACT

In this paper we formulated a new definition called 0-constant Reverse Magic Graphoidal graphs. Let G admits ψ magic graphoidal total labelling of G if there exists one-to-one map $f: V \cup E \to \{1,2,3,\ldots,m+n\}$ such that for every path P in ψ then $f^*(P) = \sum_{i=1}^{n-1} f(v_i\, v_{i+1}) - \{f(v_1) + f(v_n)\} = \mu_{rmgC} = 0(Zero)$ is a constant, where f^* is the induced labeling on ψ is called Zero-Constant Reverse Magic Graphoidal. And also proved that Binary tree and Coconut tree are Zero-Constant Reverse Magic Graphoidal Graphs.

***Keywords**: Zero-Constant Reverse Magic Graphoidal Graphs, Graphoidal Constant, Graphoidal Cover, Magic Graphoidal, reverse- magic graphoidal.*

1. INTRODUCTION

Let $G = (V, E)$ be a graph with n vertices and m edges. A graphoidal cover ψ of G is a collection of paths such that ψ
(i) Every edge is exactly one path of
(ii) Every vertex is an internal vertex of almost one path in ψ.

In1963,motivated by the notation of magic squares in number theory, ***Magic labeling*** were introduced by Sedlacek [10]. B.D. Acharya and E. Sampath Kumar defined Graphoidal cover as partition of edge set of G in to internally disjoint paths (not necessarily open). The maximum cardinality of such cover is known as graphoidal covering number of G.

A graph $G = (V, E)$ is said to be magic if there exist a bijection $f: V \cup E \to \{1,2,3 \ldots \ldots . m+n\}$. Such that for every path $P = \{v_1, v_2, \ldots \ldots, v_n\}$ in ψ. A graph G is called magic graphoidal if there exists a minimum graphoidal cover ψ of G such that G admits ψ- magic graphoidal total labelling of *G*.

Here we introduced a new type of (ie. Zero-Reverse) magic graphoidal total labeling is called Zero-reverse magic graphoidal (rmg) total labeling.

Definition 1.1: The ***Trivial graph*** K_1 or P_1 is the graph with one vertex and no edges

Definition 1.2: A ***Binary tree*** is an 2-ary tree in which every internal vertex has exactly 2 children and all leaves are at the same level.

Definition 1.3: The ***Coconut tree*** graph is obtained by identifying the vertex of $K_{1,m}$ with a pendant vertex of the path P_n

Definition 1.4: A reverse magic graphoidal labeling of a graph G is one-to-one map f from $V(G) \cup E(G) \to \{1,2,3,\ldots\ldots\ldots,m+n\}$, where '$n$' is the number of vertices of a graph and 'm' is the number of the edges of a graph, with the property that , there is an integer constant 'μ' such that
$f^*(p) = \sum_{i=1}^{n-1} f(v_i\, v_{i+1}) - \{f(v_1) + f(v_n)\} = \mu_{rmgC}$, is a contant

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II. MAIN RESULTS

Definition 2.1: Let G admits ψ magic graphoidal total labelling of G if there exists one-to-one map $f: V \cup E \rightarrow \{1,2,3,\dots,m+n\}$ such that for every path P in ψ then $f^*(P) = \sum_{i=1}^{n-1} f(v_i\, v_{i+1}) - \{f(v_1) + f(v_n)\} = \mu_{rmgC} = 0\ (Zero)$ is a constant, where f^* is the induced labeling on ψ is called ***Zero-Constant Reverse Magic Graphoidal*** .
Then the reverse methodology of Zero-constant magic graphoidal labeling is called ***Zero-constant reverse magic graphoidal labeling*** (Zero-crmgl). Reverse process of Zero-constant magic graphoidal of a graph is called ***Zero-constant reverse magic graphoidal graphs*** (Zero-crmgg).

Theorem 2.1: The binary tree is Zero-constant reverse magic graphoidal.

Proof:
Let G be the binary tree.
Let $V(G) = u_i; \quad 0 \le i \le n-1$
And $E(G) = \{(u_{i-1}\ u_{2i-1}), (u_{i-1}\ u_{2i})\}; \ 1 \le i \le \frac{n-1}{2}$
Here $m+n = 2n-1$
Define $f: V \cup E \rightarrow \{1,2,\dots\dots,m+n\}$ by

$$f(u_0) = no\ value$$
$$f(u_{2i-1}) = i; \qquad 1 \le i \le \frac{n-1}{2}$$
$$f(u_{2i}) = 2n - i \qquad 1 \le i \le \frac{n-1}{2}$$
$$f(u_{i-1}\ u_{2i-1}) = \frac{n-1}{2} + i; \qquad 1 \le i \le \frac{n-1}{2}$$
$$f(u_{i-1}\ u_{2i}) = \frac{3n+1}{2} - i; \qquad 1 \le i \le \frac{n-1}{2}$$

Let $\psi = \{P = (u_{2i-1}\, u_{i-1} u_{2i})\}$

So,

$$f^*(P) = f(u_{2i-1}\, u_{i-1}) + f(u_{i-1}\, u_{2i}) - \{f(u_{2i-1}) + f(u_{2i})\}$$
$$= \frac{n-1}{2} + i + \frac{3n+1}{2} - i - \{i + 2n - i\}$$
$$= \frac{n-1}{2} + \frac{3n+1}{2} - 2n$$
$$= \frac{4n-4n}{2} = 0 = \mu_{rmgc} \qquad (1)$$

From the above equation (1) we conclude that G admits ψ - revere magic graphoidal total labeling. The reverse magic graphoidal constant μ_{rmgc} of binary tree is '0'. Hence binary tree is Zero-reverse magic graphoidal.

Theorem 16: The Coconut tree $K_{1,n} \odot P_n$ is Zero-constant reverse magic graphoidal.

Proof:
Let G be a coconut tree.
Let $V(G) = u_i; \qquad 1 \le i \le 2n$

$$\text{And} \quad E(G) = \begin{cases} u_i\, u_{i+1}; & i \le n-1 \\ u_n\, u_{n+i}; & 1 \le i \le n \end{cases}$$

Here, $m+n = 2m+2n-1$
Define $f: V \cup E : \rightarrow \{1,2,\dots\dots,2m+2n-1\}$ by

$$f(u_1) = 2(m+n-1)$$
$$f(u_2) = 1$$
$$f(u_1 u_2) = 2m+2n-1$$

$\boldsymbol{Case\ (i)}$: $\boldsymbol{n = 0\ (mod\ 4)}$

$$f(u_{4i-2}) = i; \qquad 1 \le i \le \frac{n}{4}$$
$$f(u_{4i}) = 2(m+n-1) - i; \qquad 1 \le i \le \frac{n}{4}$$
$$f(u_{4i-2}\, u_{4i-1}) = \frac{8m+7n-8}{4} - i; \qquad 1 \le i \le \frac{n}{4}$$
$$f(u_{4i-1} u_{4i}) = \frac{n}{4} + i; \qquad 1 \le i \le \frac{n}{4}$$

$f(u_{4i}u_{4i+1}) = \dfrac{4m+3n-4}{2} - i; \qquad 1 \le i \le \dfrac{n}{4} - 1$

$f(u_{4i+1}u_{4i+2}) = \dfrac{n+2}{2} + i; \qquad 1 \le i \le \dfrac{n}{2}$

$f(u_n u_{n+2i-1}) = \dfrac{8m+3n-4}{4} - i; \qquad 1 \le i \le \dfrac{n}{2}$

$f(u_n u_{n+2i}) = \dfrac{5n}{4} + i; \qquad 1 \le i \le \dfrac{n}{2}$

$f(u_{n+2i-1}) = \dfrac{8m+5n-4}{4} - i; \qquad 1 \le i \le \dfrac{n}{2}$

$f(u_{n+2i}) = \dfrac{3n}{4} + i; \qquad 1 \le i \le \dfrac{n}{2}$

Let $\psi = \{P_1 = (u_1 u_2)$

$P_2 = (u_{4i-2}u_{4i-1}) \cup (u_{4i-1}u_{4i}); \qquad 1 \le i \le \dfrac{n}{4}$

$P_3 = (u_{4i}u_{4i+1}) \cup (u_{4i+1}u_{4i+2}); \qquad 1 \le i \le \dfrac{n}{4}$

$P_4 = (u_n u_{n+2i-1}) \cup (u_n u_{n+2i})\}; \qquad 1 \le i \le \dfrac{n}{2}$

So,

$$\begin{aligned} f^*(P_1) &= f(u_1 u_2) - \{f(u_1) + f(u_2)\} \\ &= 2m + 2n - 1 - \{2(m+n-1) + 1\} \\ &= 0 = \mu_{rmgc} \qquad (1) \end{aligned}$$

$$\begin{aligned} f^*(P_2) &= f(u_{4i-2}u_{4i-1}) + f(u_{4i-1}u_{4i}) - \{f(u_{4i-2}) + f(u_{4i})\} \\ &= \frac{8m+7n-8}{4} - i + \frac{n}{4} + i - \{i + 2(m+n-1) - i\} \\ &= 0 = \mu_{rmgc} \qquad (2) \end{aligned}$$

$$\begin{aligned} f^*(P_3) &= f(u_{4i}u_{4i+1}) + f(u_{4i+1}u_{4i+2}) - \{f(u_{4i}) + f(u_{4i+2})\} \\ &= \frac{4m+3n-4}{2} - i + \frac{n+2}{2} + i - \{2(m+n-1) - i + i + +1\} \\ &= 0 = \mu_{rmgc} \qquad (3) \end{aligned}$$

$$\begin{aligned} f^*(P_4) &= f(u_n u_{n+2i-1}) - f(u_n u_{n+2i}) - \{f(u_{n+2i-1}) + f(u_{n+2i})\} \\ &= \frac{8m+3n-4}{4} - i + \frac{5n}{4} + i - \{\frac{8m+5n-4}{4} - i + \frac{3n}{4} + i\} \\ &= 0 = \mu_{rmgc} \qquad (4) \end{aligned}$$

From the above equation (1), (2), (3) & (4) we conclude that G admits ψ - revere magic graphoidal total labeling. The reverse magic graphoidal constant μ_{rmgc} of coconut tree is '0'.. Hence coconut tree is Zero-reverse magic graphoidal.

***Case (ii)*: $n = 1 \ (mod\ 4)$**

$f(u_{4i-2}) = i; \qquad 1 \le i \le \dfrac{n+3}{4}$

$f(u_{4i}) = 2(m+n-1) - i; \qquad 1 \le i \le \dfrac{n-1}{4}$

$f(u_{4i-2}u_{4i-1}) = \dfrac{4m+3n-5}{2} - i; \qquad 1 \le i \le \dfrac{n-1}{4}$

$f(u_{4i-1}u_{4i}) = \dfrac{n+1}{2} + i; \qquad 1 \le i \le \dfrac{n-1}{4}$

$f(u_{4i}u_{4i+1}) = \dfrac{8m+7n-7}{2} - i; \qquad 1 \le i \le \dfrac{n-1}{4}$

$f(u_{4i+1}u_{4i+2}) = \dfrac{n+3}{4} + i; \qquad 1 \le i \le \dfrac{n-1}{4}$

$f(u_{n+2i}) = \dfrac{8m+5n-9}{4} - i; \qquad 1 \le i \le \dfrac{n-1}{2}$

$f(u_{n+2i+1}) = \dfrac{3n+1}{4} + i; \qquad 1 \le i \le \dfrac{n-1}{2}$

$f(u_n u_{n+2i}) = \dfrac{8m+3n-7}{4} - i; \qquad 1 \le i \le \dfrac{n-1}{2}$

$f(u_n u_{n+2i+1}) = \dfrac{5n-1}{4} + i; \qquad 1 \le i \le \dfrac{n-1}{2}$

Let $\psi = \{P_1 = (u_1u_2)$
$P_2 = (u_{4i-2}u_{4i-1}) \cup (u_{4i-1}u_{4i})$
$P_3 = (u_{4i}u_{4i+1}) \cup (u_{4i+1}u_{4i+2})$
$P_4 = (u_{n+2i}u_n) \cup (u_nu_{n+2i+1})\}$

So,

$$\begin{aligned} f^*(P_1) &= f(u_1u_2) - \{f(u_1) + f(u_2)\} \\ &= 2m + 2n - 1 - \{2m + 2n - 2 + 1\} \\ &= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}(1) \end{aligned}$$

$$\begin{aligned} f^*(P_2) &= f(u_{4i-2}u_{4i-1}) + f(u_{4i-i}\ f(u_{4i}) - \{f(u_{4i-2}) + f(u_{4i})\} \\ &= \frac{4m+3n-5}{2} - i + \frac{n+1}{2} + i - \{i + 2(m+n-1) - i\} \\ &= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}(2) \end{aligned}$$

$$\begin{aligned} f^*(P_3) &= f(u_{4i}u_{4i+1}) + f(u_{4i+1}u_{4i+2}) - \{f(u_{4i}) + f(u_{4i+2}\} \\ &= \frac{8m+7n-7}{4} - i + \frac{n+3}{4} + i - \{2(m+n-1) - i + i + 1\} \\ &= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}(3) \end{aligned}$$

$$\begin{aligned} f^*(P_4) &= f(u_{n+2i}\ u_n) - f(u_nu_{n+2i+1}) - \{f(u_{n+2i}) + f(u_{n+2i+1})\} \\ &= \frac{8m+3n-7}{4} - i + \frac{5n-1}{4} + i - \{\frac{8m+5n-9}{4} - i + \frac{3n+1}{4} + i\} \\ &= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}(4) \end{aligned}$$

From the above equation $(1), (2), (3) \& (4)$ we conclude that G admits ψ - revere magic graphoidal total labeling. The reverse magic graphoidal constant μ_{rmgc} of coconut tree is '0'. Hence coconut tree is Zero-reverse magic graphoidal.

Case (iii) : n = 2 (mod 4)

$$\begin{aligned}
f(u_{4i}) &= 2(m+n-1) - i; && 1 \le i \le \frac{n-2}{4} \\
f(u_{4i-2}) &= i; && 1 \le i \le \frac{n+2}{4} \\
f(u_{4i-2}u_{4i-1}) &= \frac{4m+3n-4}{2} - i; && 1 \le i \le \frac{n-2}{4} \\
f(u_{4i-1}u_{4i}) &= \frac{n}{2} + i; && 1 \le i \le \frac{n-2}{4} \\
f(u_{4i}u_{4i+1}) &= \frac{8m+7n-6}{4} - i; && 1 \le i \le \frac{n-2}{4} \\
f(u_{4i+1}u_{4i+2}) &= \frac{n+2}{4} + i; && 1 \le i \le \frac{n-2}{4} \\
f(u_{n+2i-1}) &= \frac{8m+5n-6}{4} - i; && 1 \le i \le \frac{n}{2} \\
f(u_{n+2i}) &= \frac{3n-2}{4} + i; && 1 \le i \le \frac{n}{2} \\
f(u_nu_{n+2i-1}) &= \frac{8m+3n-6}{4} - i; && 1 \le i \le \frac{n}{2} \\
f(u_nu_{n+2i}) &= \frac{5n-2}{4} + i; && 1 \le i \le \frac{n}{2}
\end{aligned}$$

Let $\psi = \{P_1 = (u_1u_2)$
$P_2 = (u_{4i-2}u_{4i-1}) \cup (u_{4i-1}\ u_{4i})$
$P_3 = (u_{4i}u_{4i+1}) \cup (u_{4i+1}u_{4i+2})$
$P_4 = (u_{n+2i-1}u_n) \cup (u_nu_{n+2i})\}$

So,

$$\begin{aligned} f^*(P_1) &= f(u_1u_2) - \{f(u_1) + f(u_2)\} \\ &= 2m + 2n - 1 - \{2(m+n-1) + 1\} \\ &= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}(1) \end{aligned}$$

$$\begin{aligned} f^*(P_2) &= f(u_{4i-2}u_{4i-1}) + f(u_{4i-1})\,f(u_{4i}) - \{f(u_{4i-2}) + f(u_{4i})\} \\ &= \frac{4m+3n-4}{2} - i + \frac{n}{2} + i - \{i + 2(m+n-1) - i\} \\ &= 0 = \mu_{mgc} \quad \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}(2) \end{aligned}$$

$$
\begin{aligned}
f^*(P_3) &= f(u_{4i}u_{4i+1}) + f(u_{4i+1}u_{4i+2}) - \{ f(u_{4i}) + f(u_{4i+2}\} \\
&= \frac{8m+7n-6}{4} - i + \frac{n+2}{4} + i - \{2(m+n-1) - i + i + 1 \\
&= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_}(3)
\end{aligned}
$$

$$
\begin{aligned}
f^*(P_4) &= f(u_{n+2i-1}u_n) - f(u_nu_{n+2i}) - \{ f(u_{n+2i-1}) + f(u_{n+2i})\} \\
&= \frac{8m+3n-6}{4} - i + \frac{5n-2}{4} + i - \{\frac{8m+5n-6}{4} - i + \frac{3n-2}{4} + i\} \\
&= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_}(4)
\end{aligned}
$$

From the above equation (1), (2), (3)& (4) we conclude that G admits ψ - revere magic graphoidal total labeling. The reverse magic graphoidal constant μ_{rmgc} of coconut tree is '0'. Hence coconut tree is Zero-reverse magic graphoidal.

***Case* (iv) : $n = 3 \ (mod\ 4)$**

$$
\begin{aligned}
&f(u_{4i-2}) = i; && 1 \le i \le \frac{n+1}{4} \\
&f(u_{4i}) = 2(m+n-1) - i; && 1 \le i \le \frac{n+1}{4} \\
&f(u_{4i-2}u_{4i-1}) = \frac{8m+7n-9}{4} - i; && 1 \le i \le \frac{n+1}{4} \\
&f(u_{4i-1}u_{4i}) = \frac{n+1}{4} + i; && 1 \le i \le \frac{n+1}{4} \\
&f(u_{4i}u_{4i+1}) = \frac{4m+3n-5}{2} - i; && 1 \le i \le \frac{n-3}{2} \\
&f(u_{4i+1}u_{4i+2}) = \frac{n+3}{2} + i; && 1 \le i \le \frac{n-3}{2} \\
&f(u_{n+2i}) = \frac{8m+5n-7}{4} + i; && 1 \le i \le \frac{n-1}{2} \\
&f(u_{n+2i+1}) = \frac{3n+3}{4} + i; && 1 \le i \le \frac{n-1}{2} \\
&f(u_nu_{n+2i}) = \frac{8m+3n-5}{4} - i; && 1 \le i \le \frac{n-1}{2} \\
&f(u_nu_{n+2i+1}) = \frac{5n+1}{4} + i; && 1 \le i \le \frac{n-1}{2}
\end{aligned}
$$

Let $\psi = \{P_1 = (u_1u_2)$
$P_2 = (u_{4i-2}u_{4i-1}) \cup (u_{4i-1}u_{4i})$
$P_3 = (u_{4i}u_{4i+1}) \cup (u_{4i+1}u_{4i+2})$
$P_4 = (u_{n+2i}u_n) \cup (u_nu_{n+2i+1}) \}$

So,

$$
\begin{aligned}
f^*(P_1) &= f(u_1u_2) - \{f(u_1) + f(u_2)\} \\
&= 2m + 2n - 1 - \{2(m+n-1) + 1\} \\
&= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_}(1)
\end{aligned}
$$

$$
\begin{aligned}
f^*(P_2) &= f(u_{4i-2}u_{4i-1}) + f(u_{4i-1}\ f(u_{4i}) - \{ f(u_{4i-2}) + f(u_{4i})\} \\
&= \frac{8m+7n-9}{4} - i + \frac{n+1}{4} + i - \{i + 2(m+n-1) - i\} \\
&= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_}(2)
\end{aligned}
$$

$$
\begin{aligned}
f^*(P_3) &= f(u_{4i}u_{4i+1}) + f(u_{4i+1}u_{4i+2}) - \{ f(u_{4i}) + f(u_{4i+2}\} \\
&= \frac{4m+3n-5}{2} - i + \frac{n+3}{2} + i - \{2(m+n-1) - i + i + 1\} \\
&= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_}(3)
\end{aligned}
$$

$$
\begin{aligned}
f^*(P_4) &= f(u_{n+2i}u_n) + f(u_nu_{n+2i+1}) - \{ f(u_{n+2i}) + f(u_{n+2i+1})\} \\
&= \frac{8m+3n-5}{4} - i + \frac{5n+1}{4} + i - \{\frac{8m+5n-7}{4} - i + \frac{3n+3}{4} + i\} \\
&= \frac{8m+3n-5+5n+1-8m-5n+7-3n-3}{4} \\
&= 0 = \mu_{rmgc} \quad \text{\_\_\_\_\_\_\_\_\_\_}(4)
\end{aligned}
$$

From the above equation (1), (2), (3) & (4) we conclude that G admits ψ - revere magic graphoidal total labeling. The reverse magic graphoidal constant μ_{rmgc} of coconut tree is '0'. Hence coconut tree is Zero-reverse magic graphoidal.

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