Even-odd Harmonious Labeling of Some Graphs

Dhvanik Zala, Narendra Chotaliya, Mehul Chaurasiya

Abstract: Let $G = (V, E)$ be a graph, with $n = |V(G)|$ and $n = |E(G)|$. An injective mapping $f : V(G) \to \{1, 2, \dots, 2n - 1\}$ is called an even-odd harmonious labeling of the graph G, if $\exists$ an induced edge mapping $f^* : E(G) \to \{0, 2, 4, \dots, 2(n-1)\}$ such that (i) f^* is bijective mapping (ii) $f^*(e = pq) = (f(p) + f(q))(mod\ 2n)$. The graph acquired from this labeling is called even-odd harmonious graph. In this paper, we discovered some interesting results like H-graph, comb graph, bistar graph and $< c_n^{(1)}, s_n^{(2)}, s_n^{(3)} >$ graph for even-odd harmonious labeling.

Keywords: Comb graph, Even-odd harmonious labeling, H-graph, Injective mapping

I. INTRODUCTION

Graph labeling is an engrossing and sizable research in the arena of graph theory. It trades in how vertices and edges of a graph are labelled corresponding to certain mathematical condition[1]. From Galian[5], the neoteric research development in the sphere of graph labeling is taken. The pioneer of graph labeling was A. Rosa[10]. Books of Harary[2] and D.B.west[8] are being used for the ideas and basic knowledge. The harmonious graph have instigated [3] in 1980. Z.liang et[8] set forth the odd harmonious graphs in 2009 and in 2011 P.B.saraijia etal [10] investigated the even harmonious graphs. Further Adalin Beatress and Saraijia in [2] set forth the even odd harmonious graphs. We have manifested distinct graphs, as we have collected distinct types of graphs in forms of even - odd harmonious labeling.

II. BASIC TERMINOLOGY

Definition[6] 2.1: A graph $G = (V(G), E(G))$ with n edges is called a harmonious, if there is an injective function $f : V(G) \to Z_n$ such that when each edge uv is alloted the label $(f(u) + f(v))(mod\ n)$, the resulting edge labels are different. When the graph G is tree, exactly one edge label may be used on two vertices.

Definition[7] 2.2: Let $G = (V, E)$ be a graph, with $n = |V(G)|$ and $n = |E(G)|$. $f : V(G) \to \{1, 3, 5, \dots, 2m - 1\}$ is said to be an even-odd harmonious labeling of the graph G if

an induced edge mapping $f^* : V(G) \to \{0, 2, 4, \dots, 2(n-1)\}$ such that (i) f^* is bijective mapping (ii) $f^*(e = pq) = (f(p) + f(q))(mod\ 2n)$. The graph acquired from this labeling is called even-odd harmonious graph.

Definition[8] 2.3: The H-graph of a path P_n is the graph secured from two copies of path P_n with vertices $v_1, v_2, v_3, \dots, v_n$ and $w_1, w_2, w_3, \dots, w_n$ by attaching the vertices $v_{\frac{n+1}{2}}$ and $w_{\frac{n+1}{2}}$ if m is odd and the vertices $w_{\frac{n}{2}+1}$ and $v_{\frac{n}{2}}$ if m is even.

Definition[8] 2.4: A comb graph is a graph obtained by attaching a single pendent edge to each vertex of a path. The comb graph is defined as $P_n \odot K_1$. Where $P_n = \{v_1, \dots, v_m\}$ be the path with m vertices which contains $2m$ vertices and $2m - 1$ edges.

Definition[9] 2.5: The bistar graph $B_{n,n}$ is a graph acquired from a path P_2 by attaching the root of stars S_n and S_n at the terminal vertices of P_2, the bistar graph is denoted by $B_{n,n}$.

Remark: In this paper, we use "EOHL" instead of "even-odd harmonious labeling", for the simplicity.

III. EVEN-ODD HARMONIOUS LABELING OF A CYCLIC GRAPH

Theorem 3.1: The H-graph of path P_n is an even-odd harmonious graph.

Proof: Let $G = P_n$ be the H-graph. Let $v_1, v_2, \dots, v_n, w_1, w_2, \dots, w_n$ be the vertices of graph G and

$E(G) = \{v_i v_{i+1}, w_i w_{i+1} : 1 \le i \le n-1\} \cup \{v_{\frac{n+1}{2}} w_{\frac{n+1}{2}}\}$ be the edges of G.

Note that, $p = |V(G)| = 2n$ and $q = |E(G)| = 2n - 1$. Define an injective function $f : V(G) \to \{1, 3, 5, \dots, 4n - 1\}$ such that

Case-1: When $n \equiv 1(mod\ 2)$

$$f(v_i) = \begin{cases} i & : i \equiv 1(mod\ 2) \\ 2n + i - 1 & : i \equiv 0(mod\ 2) \end{cases} \quad \text{and}$$

$$f(w_i) = \begin{cases} 3n + i - 1 & : i \equiv 1(mod\ 2) \\ n + i & : i \equiv 0(mod\ 2) \end{cases}$$

Case-2: When $n \equiv 0(mod\ 2)$

$$f(v_i) = \begin{cases} i & : i \equiv 1(mod\ 2) \\ 2n + i & : i \equiv 0(mod\ 2) \end{cases} \quad \text{and}$$

$$f(w_i) = \begin{cases} 2n - i & : i \equiv 1(mod\ 2) \\ 4n - i + 1 & : i \equiv 0(mod\ 2) \end{cases}$$

and an induced edge function

$f^* : E(G) \to \{0, 2, 4, \dots, 4n - 4\}$ such that

Case-1: When $n \equiv 1(mod\ 2)$

$f^*(v_i) = f^*(v_i v_{i+1}) = (2n + 2i)(mod\ 2q), 1 \le i \le n-1$

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* Correspondence Author
Dhvanik B. Zala*, Humanities and Science Department, Darshan Institute of Engineering and Technology, Gujarat Technological University Rajkot, India. Email: dhvanik.zala6589@gmail.com
Narendra T. Chotaliya, Department of Mathematics, Shri M. P. Shah college of science, Saurashtra University, Rajkot, India.
Email: narendra_chotaliya@yahoo.com
Mehul A. Chaurasiya, Department of Mathematics, Shri H. N. Shukla Saurashtra University, College, Rajkot, India.
Email: mehulchaurasiya73460@gmail.com

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Martin Bača,Mirka Miller,Joe Ryan,Andrea Semaničová-Feňovčíková

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K.Muthugurupackiam,S.Ramya, A new graph characteristic even modular edge irregularity strength of graphs is introduced Estimation on this parameter is obtained and the precise values of this parameter are obtained for some families of graphs

Magic and Antimagic Graphs Martin Bača,Mirka Miller,Joe Ryan,Andrea Semaničová-Feňovčíková,2019-09-14 Magic and antimagic labelings are among the oldest labeling schemes in graph theory This book takes readers on a journey through these labelings from early beginnings with magic squares up to the latest results and beyond Starting from the very basics the book offers a detailed account of all magic and antimagic type labelings of undirected graphs Long standing problems are surveyed and presented along with recent results in classical labelings In addition the book covers an assortment of variations on the labeling theme all in one self contained monograph Assuming only basic familiarity with graphs this book complete with carefully written proofs of most results is an ideal introduction to graph labeling for students learning the subject More than 150 open problems and conjectures make it an invaluable guide for postgraduate and early career researchers as well as an excellent reference for established graph theorists   Some Results on 4-Total Difference Cordial Graphs R. Ponraj, A graph with admits a k total di erence cordial labeling is called k total di erence cordial graphs

Distance-two Constrained Labeling and List-labeling of Some Graphs Haiying Zhou,2013   *From Multi-prime to Subset Labelings of Graphs* Bethel I. McGrew,2021 A graph labeling is an assignment of labels elements of some set to the vertices or edges or both of a graph G If only the vertices of G are labeled then the resulting graph is a vertex labeled graph If only the edges are labeled the resulting graph is an edge labeled graph The concept was first introduced in the 19th century when Arthur Cayley established Cayley s Tree Formula which proved that there are n n 2 distinct labeled trees of order n Since then it has grown into a popular research area In this study we first review several types of labelings then turn to the particular problem of multi prime labelings where products of distinct primes are assigned as labels that are disjoint for adjacent vertices and intersecting for non adjacent vertices We express the problem in the equivalent language of subset labelings denoting elements in a label by their indices 1 2 k A graph s subset index is the smallest number of elements k from which we can assign a subset labeling f considered as a function with domain V G and range P k i e the power set of k with the empty set omitted It turns out that the problem of determining the subset index for graph classes such as paths and cycles is nontrivial For paths of order n we determine the index up to n 24 and for cycles of order n we determine it up to n 18 We also describe the connection between the problem of determining the subset index of a graph and a combinatorics problem related to the so called Erd s Ko Rado Theorem namely the problem of determining the largest possible family of sets such that every set is disjoint from at most some fixed number of sets in the collection Our work on subset labelings of cycles in particular has resulted in the correction of a significant research result in this area reopening the problem for further research We also consider the problem of determining the subset index for other graph classes including prisms and grids for which we present upper bounds in terms of the subset indices of paths and cycles We conclude by studying the

problem for select graph unions **Distance Two Labeling of Some Products of Graphs** Qiong Wu,Hong Kong Baptist University. Department of Mathematics,2013 Cordial Labeling of Some New and Existing Classes of Graphs Alice Lacaze-Masmonteil,2016

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