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Some Labeling for Duplicate Graph of Double Quadrilateral Flow Graph

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Some Labeling for Duplicate Graph of Double Quadrilateral Flow Graph

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ABSTRACT--The Graph theory is sort of complicated events into the structure they are reflected by the clear graphs, most of their graphs separated into each component when the characteristics of mother graphs are determined by the properties of their components (or) copies. Based these, E. Sampath kumar introduced the concept of duplicate graph of a mother Graph (1974). Duplicate graph (DG) means obtained by a finite undirected graph without or with and without multiple edges. Let G (V, E) be simple a graph. A duplicate graph of G is DG = (V1, E1), when the vertex set V1 = V U V′ and V $\cap$ V′ = ϕ and f: V → V′ is one-one onto and the edge set E1 of DG is defined as: The edge ab is in E if and only if both ab′ and a′b are edges in E1. [2] Many scholars to prove some labeling for duplicate graph of some mother graphs. few scholars P. Vijayakumar, P.P. Ulaganathan and K. Thirusangu, have prove existence as some cordial labeling in duplicate graph of Star Graph [5]. P.Indira, B.Selvam, K.Thirusangu they have proved total 3 - sum cordial and product E- cordial labeling for the extended duplicate graph Of Quadrilateral snake graph [8]. E.Nanda gopal, V.Maheswari, P.Vijaya kumar have proved special labeling for the extended duplicate graph of Quadrilateral snake graph. [7]. in this paper, we prove that the Cordial, Product cordial and Sum divisor 3-equitable cordial labeling in Duplicate graph of Double Quadrilateral Flow Graph.

Key words - Double Quadrilateral, Duplicate graph, Cordial, Product, Sum divisor, 3-Equitable.

1. PRELIMINARIES

Definition 1.1 A function $f : V \to \{0,1\}$, defines that each edge xy receives the label $f(x).f(y)$ is a Product cordial means, If the number of receive label 0 and the number receive label 1 difference at most one and also the number of edges receive label 0 and the number of edges receive label 1 difference at most one. [5]

Definition 1.2 A function $f : V \to \{0,1\}$ such that each edge uv receive the label $f(u) * f(v)$ is a total Product cordial labeling means, if the number of vertices and edges labeled with '0' differ by at most one from the number of vertices and edges labeled with '1'. A graph which admits cordial labeling is called total product cordial labeling. [12]

Definition 1.3 A function $f : V \to \{0 , 1\}$ is said to be a cordial labeling if each edge uv has the label $|f(u) - f(v)|$ such that the number of vertices labeled '0' and the number of vertices labeled '1'differ by at most one and the number of edges labeled '0' and the number of edges labeled '1' differ by at most one. [6]

Definition 1.4 A function $f : V \to \{0 , 1\}$ such that each edge uv which is assigned the label $|f(u)- f(v)|$ is said to be total cordial labeling if the number of vertices and edges labeled with '0' differ by at most one

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from the number of vertices and edges labeled with ‘1’. A graph which admits cordial labeling is called total cordial.[5]

Definition 1.5 A sum divisor 3-Equitable cordial labeling of a graph G with vertex set V is a one-one onto $f : V \rightarrow \{0, 1, 2\}$ define that the each edge uv is assigned the label 1, if 2 divides $|(f(u + f(v))|$ and the label 0 otherwise, and the number of edges labeled with ‘1’and the number of edges labeled with ‘0’ differ at most one.

Definition 1.6 The Double Quadrilateral Flow Graph $\{DQF_m\}$ obtained from path $\{u_1, u_2 \dots \dots u_m\}$ by joining u_i and u_{i+1} to four new vertices v_i , w_i , x_i , y_i respectively and then joining , v_i and w_i and x_i and y_i . It’s Duplicate graph of the Double Quadrilateral flow Graph $DG(DQF_m)$, $m \geq 2$. Here ‘m’ is the number edges of a path by a circle C_6, and 10m +2 vertices and 14m edges. [1]

2. MAIN RESULTS

Algorithm: 2.0 Construction of duplicate graph of Double Quadrilateral Flow Graph $DG(DQF_m)$, $m \geq 2$

Let the vertices V defined as $v_1, v_2, v_3 \dots, v_{5m+1}$. $v_1', v_2', \dots \dots v'_{5m+1}$ and the edges E defined as $e_1, e_2 \dots, e_{7m}$. $e_1', e_2', \dots \dots e'_{7m}$.

If $1 \leq k \leq m$

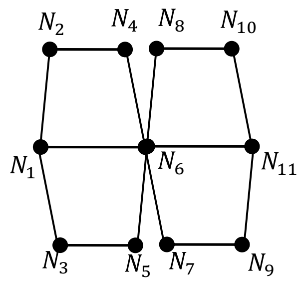
$\emptyset(v_{5k-4}\, v'_{5k-3}) \rightarrow e_{7k-6}$, $\emptyset(v_{5k-4} v'_{5k-2}) \rightarrow e_{7k-5}$, $\emptyset(v_{5k-4} v'_{5k+1}) \rightarrow e_{7k-4}$, $\emptyset(v_{5k-3} v'_{5k-1}) \rightarrow e_{7k-3}$,

$\emptyset(v_{5k-2} v'_{5k}) \rightarrow e_{7k-2}$, $\emptyset(v_{5k-1}\, v'_{5k+1}) \rightarrow e_{7k-1}$, $\emptyset\,(v_{5k} v'_{5k+1}) \rightarrow e_{7k}$.

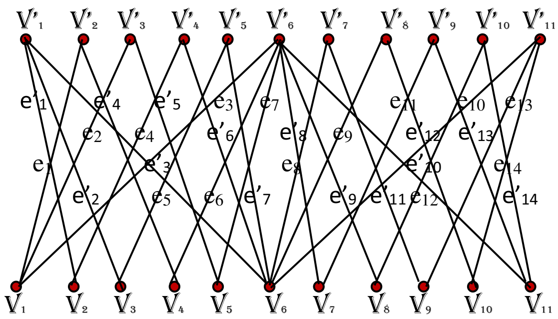
$\emptyset(v'_{5k-4} v_{5k-3}) \leftarrow e'_{7k-6}$, $\emptyset(v'_{5k-4} v_{5k-2}) \leftarrow e'_{7k-5}$, $\emptyset\,(v'_{5k-4} v_{5k+1}) \leftarrow e'_{7k-4}$, $\emptyset\,(v'_{5k-3} v_{5k-1}) \leftarrow e'_{7k-3}$,

$\emptyset(v'_{5k-2} v_{5k}) \leftarrow e'_{7k-2}$, $\emptyset(v'_{5k-1} v_{5k+1}) \leftarrow e'_{7k-1}$, $\emptyset(v'_{5k} v_{5k+1}) \leftarrow e'_{7k}$.

ILLUSTRATION:



Double Quadrilateral flow graph



Duplicate graph: $DG(DQF_2)$

The Duplicate graph of Double Quadrilateral Flow Graph $DG(\ DQF_m\ )\ \ m \geq 2$, when contains 10m+2 vertices and 14m edges.

3. Cordial labeling

Theorem 1: The Duplicate graph of Double Quadrilateral Flow graph $\mathbf{DG(DQF_m\ )}$, $\mathbf{m \geq 2}$, admits cordial labeling.

Algorithm: 3.0 Assignment of labels to vertices

Let the vertices V defined as $v_1,\ v_2,\ v_3 \ldots\ldots, v_{5m+1}.\ v_{1'},\ v_{2'}, \ldots \ldots . v'_{5m+1}$ and the edges E defined as e, $e_2,\ e_3 \ldots\ldots, e_{7m}.\ e_{1'},\ e_{2'}, \ldots \ldots\ e'_{7m}$.

Case (1): when m is Even

do

{

if $1 \leq k \leq \frac{m}{2}$

{

$f(\mathrm{v}_{10\mathrm{k}-9}) = f(\mathrm{v}_{10\mathrm{k}-7}) = f(\mathrm{v}_{10\mathrm{k}-5}) = f\ (\mathrm{v}_{10\mathrm{k}-1}) = 1.$

$f(\mathrm{v}_{10\mathrm{k}-3}) = f(\mathrm{v}_{10\mathrm{k}-2}) = f(\mathrm{v}_{10\mathrm{k}}) = f(\ \mathrm{v}_{10\mathrm{k}-8}) = f(\ \mathrm{v}_{10\mathrm{k}-6}) = f(\mathrm{v}_{10\mathrm{k}-4}) = 0.$

$f(\mathrm{v'}_{10\mathrm{k}-9}) = f(\mathrm{v'}_{10\mathrm{k}-5}) = f(\mathrm{v'}_{10\mathrm{k}}) = f(\mathrm{v'}_{10\mathrm{k}-4}) = 0.$

$f(\mathrm{v'}_{10\mathrm{k}-1}) = f(\mathrm{v'}_{10\mathrm{k}-2}) = f(\mathrm{v'}_{10\mathrm{k}-3}) = f(\mathrm{v'}_{10\mathrm{k}-6}) = f(\mathrm{v'}_{10\mathrm{k}-7}) = f(\mathrm{v'}_{10\mathrm{k}-8}) = 1$

}

if $k = 5m + 1$

$f(\mathrm{v_k}) = 1.\ f(\mathrm{v'_k}) = 0.$

} End the Processes.

Case (2): when m is Odd

do

{

if $1 \leq k \leq \frac{m+1}{2}$

{

$f(\ \mathrm{v}_{10\mathrm{k}-9}) = f(\ \mathrm{v}_{10\mathrm{k}-7}) = f(\mathrm{v}_{10\mathrm{k}-5}) = 1.\ f(\mathrm{v}_{10\mathrm{k}-8}) = f(\ \mathrm{v}_{10\mathrm{k}-6}) = f(\mathrm{v}_{10\mathrm{k}-4}) = 0.$

$f(\mathrm{v'}_{10\mathrm{k}-9}) = f(\mathrm{v'}_{10\mathrm{k}-5}) = f(\mathrm{v'}_{10\mathrm{k}-4}) = 0.f(\ \mathrm{v'}_{10\mathrm{k}-8}) = 1.f(\ \mathrm{v'}_{10\mathrm{k}-7}) = 1.f(\ \mathrm{v'}_{10\mathrm{k}-6}) = 1.$

} End the Processes.

if $1 \leq k < \frac{m+1}{2}$

{
$f(\mathrm{v}_{10k-3}) = f(\mathrm{v}_{10k-2}) = f(\mathrm{v}_{10k}) = 0. f(\mathrm{v}_{10k-1}) = 1.$

$f(\mathrm{v'}_{10k-3}) = f(\mathrm{v'}_{10k-2}) = f(\mathrm{v'}_{10k-1}) = 1. f(\mathrm{v'}_{10k}) = 0.$
}

if $k = 5m + 1$

$f(\mathrm{v}_k) = 0. f(\mathrm{v'}_k) = 0.$

} End the Processes. **Thus 5m+1 received label 0 and 5m+1 received label 1.**

Hence Double Quadrilateral flow graph 10m+2 vertices received label either 0 or 1.

Algorithm: 3.1 Assignment of labels to edges

The induced the maps $f^*: E \to \{0,1\}$ defined by $f^*(uv) = |f(u) - f(v)|$,

Case (1): when m is Even.
For i=2 to m step 2

{

do

{

$f^*(\mathrm{e}_{7i-13}) = f^*(\mathrm{e}_{7i-12}) \to 0$ /*up to m edges*/

$f^*(\mathrm{e}_{7i-8}) = f^*(\mathrm{e}_{7i-4}) = f^*(\mathrm{e}_{7i-2}) = f^*(\mathrm{e}_{7i}) \to 0$ /* up to 2m edges*/

$f^*(\mathrm{e'}_{7i-6}) = f^*(\mathrm{e'}_{7i-5}) = f^*(\mathrm{e'}_{7i-3}) = f^*(\mathrm{e'}_{7i-1.}) \to 0$ /* up to 2m edges*/

$f^*(e'_{7i-13}) = f^*(e'_{7i-11}) = f^*(e'_{7i-9}) = f^*(e'_{7i-7}) \to 0$ /* up to 2m edges*/

} End the processes. **Thus the 7m edges received label 0.**

do

{

$f^*(\mathrm{e}_{7i-11}) = f^*(\mathrm{e}_{7i-10}) = f^*(\mathrm{e}_{7i-9}) \to 1$ /∗ up to $\frac{3\mathrm{m}}{2}$ edges ∗/

$f^*(\mathrm{e}_{7i-6}) = f^*(\mathrm{e}_{7i-5}) = f^*(\mathrm{e}_{7i-3}) = f^*(\mathrm{e}_{7i-1}) \to 1$ /∗ up to 2m edges ∗/

$f^*(e_{7i-7.}) \to 1$ /∗ up to $\frac{\mathrm{m}}{2}$ edges ∗/

$f^*(e'_{7i.}) \to 1$ /∗ up to $\frac{\mathrm{m}}{2}$ edges ∗/

$f^*(e'_{7i-4}) = f^*(e'_{7i-2}) \to 1 /* up\ to\ m\ \ edges */$

$f^*(e'_{7i-12}) = f^*(e'_{7i-10}) = f^*(e'_{7i-8}) \to 1 /* up\ to \frac{3m}{2} edges */$

} End the processes. **Thus the 7m edges received label 1.**

Hence, Double Quadrilateral flow graph of even numbered paths has 14m edges received either 0 or 1.

Case (2): when m is Odd.

For i=3 to m step 2

{

do

{

$f^*(\mathrm{e}_{7\mathrm{i}-20'}) = f^*(\mathrm{e}_{7\mathrm{i}-19}) = f^*(\mathrm{e}_{7\mathrm{i}-6}) = f^*(\mathrm{e}_{7\mathrm{i}-5}) \rightarrow 0$ /*up to $m+1$ edges*/

$f^*(e_{7i-15}) = f^*(e_{7i-1}) \rightarrow 0$ /* up to $\frac{m+1}{2}$ edges*/

$f^*(\mathrm{e}_{7\mathrm{i}-11}) = f^*(\mathrm{e}_{7\mathrm{i}-9}.) \rightarrow 0$ /* up to m-1 edges*/

$f^*(e_{7i-7}) \rightarrow 0$ /* up to $\frac{m-1}{2}$ edges*/

$f^*(\mathrm{e}'_{7\mathrm{i}-13}) = f^*(\mathrm{e}'_{7\mathrm{i}-12}) = f^*(\mathrm{e}'_{7\mathrm{i}-10}) = f^*(\mathrm{e}'_{7\mathrm{i}}) = f^*(\mathrm{e}'_{7\mathrm{i}-8}) = f^*(\mathrm{e}'_{7\mathrm{i}-4}) = f^*(\mathrm{e}'_{7\mathrm{i}-2}) = f^*(\mathrm{e}'_{7\mathrm{i}}) \rightarrow 0$ /*up to $2m+2$ edges*/

$f^*(\mathrm{e}'_{7\mathrm{i}-12}) = f^*(\mathrm{e}'_{7\mathrm{i}-10}) = f^*(\mathrm{e}'_{7\mathrm{i}-8}.) \rightarrow 0$ /* up to $2m-2$ edges*/

} End the processes. **Thus the 7m edges received label 0.**

do

{

$f^*(\mathrm{e}_{7\mathrm{i}-18}) = f^*(\mathrm{e}_{7\mathrm{i}-17}) = f^*(\mathrm{e}_{7\mathrm{i}-16}) = f^*(\mathrm{e}_{7\mathrm{i}-14}) = f^*(\mathrm{e}_{7\mathrm{i}-4}) = f^*(\mathrm{e}_{7\mathrm{i}-3}) = f^*(\mathrm{e}_{7\mathrm{i}}) \rightarrow 1$ $/*$ up to $2\mathrm{m}+2$ edges $*/$

$f^*(\mathrm{e}_{7\mathrm{i}-13}) = f^*(\mathrm{e}_{7\mathrm{i}-12}) = f^*(\mathrm{e}_{7\mathrm{i}-10}) = f^*(\mathrm{e}_{7\mathrm{i}-8}) \rightarrow 1$ $/*$ up to $2\mathrm{m}-2$ edges $*/$

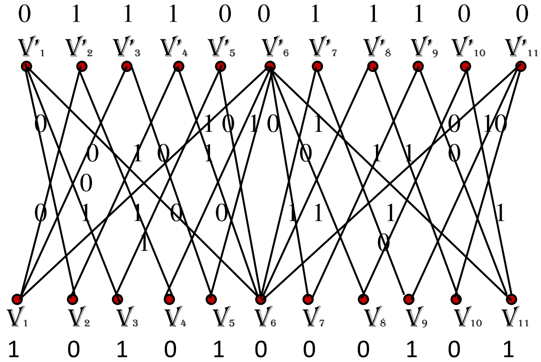
$f^*(e'_{7i-19}) = f^*(e'_{7i-17}) = f^*(e'_{7i-5}) = f^*(e'_{7i-3}) = f^*(e'_{7i-1}) \rightarrow 1$ $/*$ up to $\frac{3}{2}(m+1)$ edges $*/$

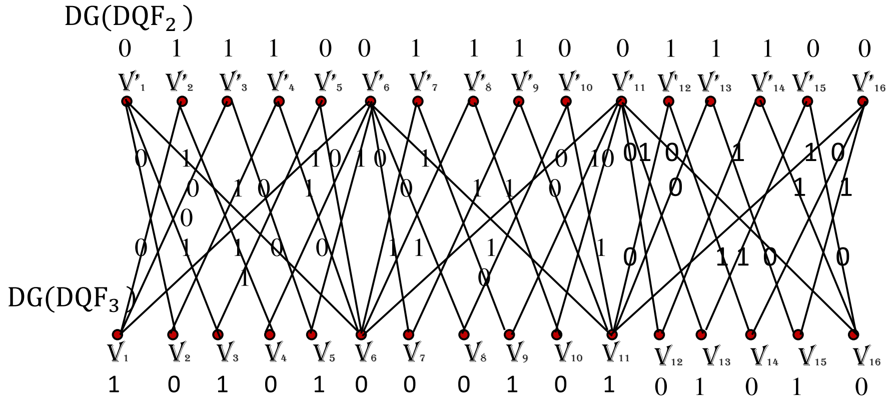
$f^*(\mathrm{e}'_{7\mathrm{i}-11}) = f^*(\mathrm{e}'_{7\mathrm{i}-9}) = f^*(\mathrm{e}'_{7\mathrm{i}-14}) \rightarrow 1$ $/*$ up to $\frac{3}{2}(m-1)$ edges $*/$

} End the processes. **Thus the 7m edges received label 1.**

Hence, Double Quadrilateral flow graph of odd numbered paths has 14m edges received either 0 or 1.

ILLUSTRATION:





Hence, the duplicate graph of Double Quadrilateral Flow graph $\mathrm{DG}(\mathrm{QF_m})$, $m \geq 2$, admits cordial labeling.

Theorem 2: The Duplicate graph of Double Quadrilateral Flow Graph $\mathrm{DG}(\mathrm{DQF_m})$, $m \geq 2$, admits total Cordial.

Proof: From theorem 1, we observe $12\mathrm{m} + 2$ vertices and edges labeled with 1 and $12\mathrm{m} + 1$ vertices and edges labeled with 0 which is difference at most one. Hence the extended duplicate graph of the Double Quadrilateral $DG(\mathrm{QF_m})$, m≥2 admits total Cordial. [1.4]

4. Product Labeling

Theorem 3: The Duplicate graph of Double Quadrilateral Flow graph $\mathrm{DG}(\mathrm{DQF_m})$, m≥2, admits Product cordial labeling.

Algorithm: 4.0 Assignment of labels to vertices

Let the vertices V defined as $v_1,\ v_2,\ v_3 \ldots\ldots, v_{5m+1}.\ v_{1'},\ v_{2'}, \ldots\ldots.v'_{5m+1}$ and the edges E defined as $e,\ e_2,\ e_3 \ldots\ldots, e_{7m}.\ e_{1'},\ e_{2'}, \ldots\ldots\ e'_{7m}$.

Case (1): when m is Even

do

{
Fix $v_1 \leftarrow 0\ \ v'_1 \leftarrow 1$
}

do

{
if $1 \leq k \leq \frac{m}{2}$

do

{

$f(v_{10k-6}) = f(v_{10k-5}) = f(v_{10k-3}) = f(v_{10k-2}) = 0.$

$f(v_{10k-8}) = f(v_{10k-7}) = f(v_{10k-1}) = f(v_{10k}) = f(v_{10k-4}) = 1$

$f(v'_{10k-6}) = f(v'_{10k-5}) = f(v'_{10k-3}) = f(v'_{10k-2}) = 1.$

$f(v'_{10k-8}) = f(v'_{10k-7}) = f(v'_{10k-1}) = f(v'_{10k}) = f(v'_{10k-4}) = 0.$

}
do

{

if $k = 5m + 1$

$f(v_k) = 0. f(v'_k) = 1.$

} End the Processes.

Case (2): when m is Odd

do
{
if $1 \leq k \leq \frac{m+1}{2}$
{
$f(v_{10k-9}) = f(v_{10k-6}) = f(v_{10k-5}) = 0. f(v_{10k-8}) = f(v_{10k-7}) = 1.$

$f(v'_{10k-9}) = f(v'_{10k-6}) = f(v'_{10k-5}) = 1. f(v'_{10k-8}) = f(v'_{10k-7}) = 0.$
{
do
{
if $1 \leq k < \frac{m+1}{2}$
{
$f(v_{10k-4}) = f(v_{10k-1}) = f(v_{10k}) = 1. f(v_{10k-3}) = f(v_{10k-2}) = 0.$

$f(v'_{10k-4}) = f(v'_{10k-1}) = f(v'_{10k}) = 0. f(v'_{10k-3}) = f(v'_{10k-2}) = 1.$

For $k = 5m + 1$

$f(v_k) = 1. f(v'_k) = 0$

} End the Processes. **Thus 5m+1 received label 0 and 5m+1 received label 1.**

Hence Double Quadrilateral flow graph 10m+2 vertices received label either 0 or 1 respectively.

Algorithm: 4.1 Assignment of labels to edges

The induced the maps $f^*: E \to \{0,1\}$ defined by $f^*(uv) = f(u).f(v)$,

Case (1): when m is Even.

For i=2 to m step 2

{

do

{

$f^*(\mathrm{e}_{7\mathrm{m}-13}) = f^*(\mathrm{e}_{7\mathrm{m}-11}) \to 0$ /*up to $\frac{3m}{2}$ edges*/

$f^*(e_{7m-8}) = f^*(e_{7m-7}) = f^*(e_{7m-3}) = f^*(e_{7m-2}) \to 0$ /* up to 2m edges*/

$f^*(\mathrm{e}'_{7\mathrm{m}-6}) = f^*(\mathrm{e}'_{7\mathrm{m}-5}) = f^*(\mathrm{e}'_{7\mathrm{m}-2}) \to 0$ /* up to $\frac{3m}{2}$ edges*/

$f^*(e'_{7m-10}) = f^*(e'_{7m-9}) = f^*(e'_{7m-1}) = f^*(e'_{7m}) \to 0$ /* up to $2m$ edges*/

} End the processes. **Thus the 7m edges received label 0.**

do

{

$f^*(\mathrm{e}_{7\mathrm{m}-6}) = f^*(\mathrm{e}_{7\mathrm{m}-5}) = f^*(\mathrm{e}_{7\mathrm{m}-2}) \to 1$ /* up to $\frac{3m}{2}$ edges*/

$f^*(e_{7m-10}) = f^*(e_{7m-9}) = f^*(e_{7m-1}) = f^*(e_{7m}) \to 1$ /* up to 2m edges*/

$f^*(\mathrm{e}'_{7\mathrm{m}-13}) = f^*(\mathrm{e}'_{7\mathrm{m}-12}) = f^*(\mathrm{e}'_{7\mathrm{m}-11}) \to 1$ /*up to $\frac{3m}{2}$ edges*/

$f^*(e'_{7m-8}) = f^*(e'_{7m-7}) = f^*(e'_{7m-3}) = f^*(e'_{7m-2}) \to 1$ /* up to $2m$ edges*/

} End the processes. **Thus the 7m edges received label 1.**

Hence, Double Quadrilateral flow graph of even numbered paths has 14m edges received either 0 or 1.

Case (2): when m is Odd

For i=2 to m step 3

{
do
{

$f^*(\mathrm{e}_{7\mathrm{i}-20}) = f^*(\mathrm{e}_{7\mathrm{i}-19}) = f^*(\mathrm{e}_{7\mathrm{i}-18}) = f^*(\mathrm{e}_{7\mathrm{i}-6}) = f^*(\mathrm{e}_{7\mathrm{i}-5}) = f^*(\mathrm{e}_{7\mathrm{i}-4}) \to 0$ /* up to $\frac{3}{2}(\mathrm{m} + 1)$ edges */

$f^*(\mathrm{e}_{7\mathrm{i}-15}) = f^*(\mathrm{e}_{7\mathrm{i}-14}) = f^*(\mathrm{e}_{7\mathrm{i}-1}, \mathrm{e}_{7\mathrm{i}}) \to 0$ /* up to $\mathrm{m} + 1$ edges */

$f^*(e_{7i-10}) = f^*(\mathrm{e}_{7i-9}) \to 0$ /* up to $\mathrm{m} - 1$ edges */

$f^*(\mathrm{e'}_{7\mathrm{i}-13}) = f^*(\mathrm{e'}_{7\mathrm{i}-12}) = f^*(\mathrm{e'}_{7\mathrm{i}-11}) \rightarrow 0$ /∗ up to $\frac{3}{2}(\mathrm{m}-1)$ edges ∗/

$f^*(\mathrm{e'}_{7\mathrm{i}-17}) = f^*(\mathrm{e'}_{7\mathrm{i}-16}) = f^*(\mathrm{e'}_{7\mathrm{i}-3}) = f^*(\mathrm{e'}_{7\mathrm{i}-2}) \rightarrow 0$ /∗ up to m + 1 edges ∗/

$f^*(e'_{7i-8}) = f^*(\mathrm{e'}_{7i-7}) \rightarrow 0$ /∗ up to m − 1 edges ∗/

} End the processes. **Thus the 7m edges received label 0.**

do
{

$f^*(e_{7i-13}) = f^*(e_{7i-12}) = f^*(e_{7i-11},) \rightarrow 1 /* \, up \, to \, \frac{3}{2}(m-1) \, edges */$

$f^*(e_{7i-17}) = f^*(e_{7i-16}) = f^*(e_{7i-3}) = f^*(e_{7i-2}) \rightarrow 1 /* \, up \, to \, m+1 \, edges */$

$f^*(e_{7i-8}) = f^*(e_{7i-7}) = 1 /* \, up \, to \, m-1 \, edges */$

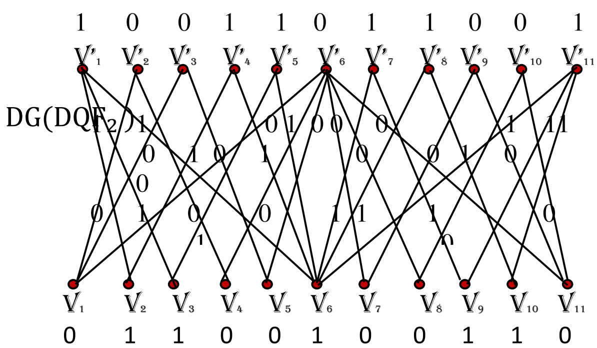
$$f^*(e'_{7i-20}) = f^*(e'_{7i-19}) = f^*(e'_{7i-18}) = f^*(e'_{7i-6}) = f^*(e'_{7i-5}) = f^*(e'_{7i-4}) \rightarrow 1 /* \, up \, to \, \frac{3}{2}(m+1) \, edges */$$

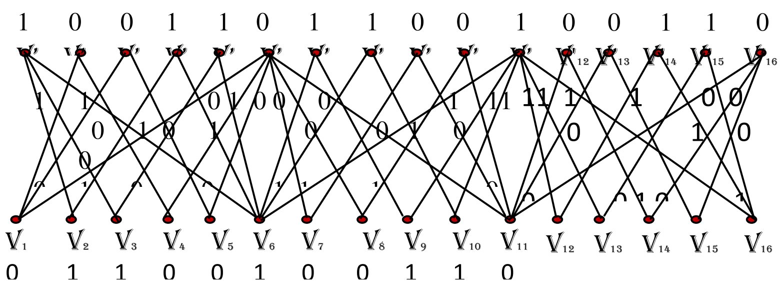
$f^*(e'_{7i-15}) = f^*(e'_{7i-14}) = f^*(e'_{7i-1}) = f^*(e'_{7i}) \rightarrow 1 /* \, up \, to \, m+1 \, edges */$

$f^*(e'_{7i-10}) = f^*(e'_{7i-9}) \rightarrow 1 /* \, up \, to \, m-1 \, edges */$

} End the processes. **Thus the 7m edges received label 1.**
Hence, Double Quadrilateral flow graph of odd numbered paths has 14m edges received either 0 or 1.

ILLUSTRATION:





$DG(DQF_3)$

Hence the duplicate graph of the Double Quadrilateral flow $DG(QF_m)$, $m \geq 2$, admits Product cordial labeling.

Theorem 4: The Duplicate graph of Double Quadrilateral $DG(DQF_m)$, $m \geq 2$, admits total product Cordial.

Proof: From theorem 3, we observe that the number of vertices and edges labeled with 0 is $12m + 2$ and the number of vertices and edges labeled with 1 is $12m + 1$ which difference at most one. Hence the extended duplicate graph of the Double Quadrilateral $DG(QF_m)$, m≥2, admits total product Cordial.[1.2]

5. Sum divisor of 3-equitable cordial Labeling

Theorem 5: The Duplicate graph of Double Quadrilateral Flow graph $DG(DQF_m)$, $m \geq 2$, admits Sum divisor of 3-equitable cordial labeling.

Algorithm 5.0: Assignment of labels to vertices

Let the vertices V defined as $v_1, v_2, v_3 \ldots\ldots, v_{5m+1}$. $v_1', v_2', \ldots\ldots. v'_{5m+1}$ and the edges E defined as e, $e_2, e_3 \ldots\ldots, e_{7m}$. $e_1', e_2', \ldots\ldots. e'_{7m}$.

Case (1): when m is Even

do

{
Fix $v_1 \leftarrow 2$ $v'_1 \leftarrow 1$
}

do

{
if $1 \leq k \leq \frac{m}{2}$

do

{

$f(v_{10k-8}) = f(v_{10k-6}) = f(v_{10k-4}) = 2. f(v_{10k-7}) = f(v_{10k-3}) = f(v_{10k-1}) = 1.$

$f(v_{10k-2}) = f(v_{10k-5}) = f(v_{10k}) = 0$

$f(v'_{10k-8}) = f(v'_{10k-5}) = f(v'_{10k-4}) = f(v'_{10k-1}) = 0. f(v'_{10k-7}) = f(v'_{10k-6}) = f(v'_{10k-2}) = 1.$

$f(v'_{10k-3}) = f(v'_{10k}) = 2.$

}

do

{

if $k = 5m + 1$

$f(\mathrm{v_k}) = 2.\ f(\mathrm{v'_k}) = 1.$

} End the Processes.

Case (2): when m is Odd

do
{
if $1 \leq k \leq \frac{m+1}{2}$
{
$f\mathrm{v}_{10k-9}) = f(\mathrm{v}_{10k-8}) = f(\mathrm{v}_{10k-4}) = f(\mathrm{v}_{10k-6}) = 2.\ f(\mathrm{v}_{10k-5}) = 0. f(\mathrm{v}_{10k-7}) = 1.$

$f(\mathrm{v'}_{10k-9}) = f(\mathrm{v'}_{10k-7}) = f(\mathrm{v'}_{10k-6}) = 1.\ f(\mathrm{v'}_{10k-5}) = f(\mathrm{v'}_{10k-4}) = f(\mathrm{v'}_{10k-8}) = 0.$
{
do
{
if $1 \leq k < \frac{m+1}{2}$
{
$f(\mathrm{v}_{10k-3}) = f(\mathrm{v}_{10k-1}) = 1. f(\mathrm{v}_{10k-2}) = f(\mathrm{v}_{10k}) = 0.$

$f(\mathrm{v'}_{10k-3}) = f(\mathrm{v'}_{10k}) = 2. f(\mathrm{v'}_{10k-2}) = 1.\ f(\mathrm{v'}_{10k-1}) = 0.$

} End the Processes. **Thus 10m+2 vertices received label 0, 1 and 2.**

Algorithm: 5.1 Assignment of labels to edges

The induced the maps $f^*: E \to \{0,1,2.\}$ defined by each edge uv is assigned the label 1, if 2 divides $|f(u) - f(v)|$ and the label 0 otherwise,

Case (1): when m is Even.

For i=2 to m step 2

{

do

{

$f^*(\mathrm{e}_{7m-5}) = f^*(\mathrm{e}_{7m-4}) = f^*(\mathrm{e}_{7m-3}.) \to 1$ /*up to $\frac{3m}{2}$ edges*/

$f^*(e_{7m-10}) = f^*(e_{7m-9}) = f^*(\mathrm{e}_{7m-12}) = f^*(\mathrm{e}_{7m}) \to 1$ /* up to 2m edges*/

$f^*(e'_{7m-13}) = f^*(e'_{7m-11}) = f^*(e'_{7m-6}) \to 1$ /* up to $\frac{3m}{2}$ edges*/

$f^*(e'_{7m-9}) = f^*(e'_{7m-8}) = f^*(e'_{7m-3} = f^*(e'_{7m-2}) \to 1$ /* up to2m edges*/

} End the processes. **Thus the 7m edges received label 1.**

do

{

$f^*(e_{7m-8}) = f^*(e_{7m-7}) = f^*(e_{7m-6}) \to 0$ /* up to $\frac{3m}{2}$ edges*/

$f^*(e_{7m-13}) = f^*(e_{7m-11}) = f^*(e_{7m-2}) \to f^*e_{7m-1}) \to 0$ /* up to 2m edges*/

$f^*(e'_{7m-12}) = f^*(e'_{7m-7}) = f^*(e'_{7m-4}) \to 0$ /*up to $\frac{3m}{2}$ edges*/

$f^*(e'_{7m-5}) = f^*(e'_{7m-4}) = f^*(e'_{7m-1}) \to f^*e'_{7m}) \to 0$ /* up to $2m$ edges*/

} End the processes. **Thus the 7m edges received label 0.**

Hence, Double Quadrilateral flow graph of even numbered paths has 14m edges received 0, 1and 2.

Case (2): when m is Odd

For i=2 to m step 3

{

do

{

$f^*(e_{7i-20}) = f^*(e_{7i-18}) = f^*(e_{7i-15}) = f^*(e_{7i-6}) = f^*(e_{7i-4}) = f^*(e_{7i-1}) \to 0$ /* up to $\frac{3}{2}(m + 1)$ edges */

$f^*(e_{7i-14}) = f^*(e_{7i}) \to 0$ /* up to $\frac{m+1}{2}$ edges */

$f^*(e'_{7i-10}) \to 0$ /* up to $\frac{m-1}{2}$ edges */

$f^*(e'_{7i-5}) = f^*(e'_{7i-1}) = f^*(e'_{7i}) \to 0$ /* up to $\frac{3}{2}(m+1)$ edges */

$f^*(e'_{7i-12}) = f^*(e'_{7i-11}) = f^*(e'_{7i-8}) \to 0$ /* up to $\frac{3}{2}(m-1)$ edges */

$f^*(e_{7i-13}) = f^*(e_{7i-9}) = f^*(e_{7i-8}) \to 0$ /* up to $\frac{3}{2}(m-1)$ edges */

} End the processes. **Thus the 7m edges received label 0.**

do

{

$f^*(e_{7i-2}) = f^*(e_{7i-3}) = f^*(e_{7i-5},) \rightarrow 1$ /* up to $\frac{3}{2}(m+1)$ edges */

$f^*(e_{7i-12}) = f^*(e_{7i-11}) = f^*(e_{7i-10}) \rightarrow 1$ /* up to $\frac{3}{2}(m-1)$ edges */

$f^*(e_{7i-7}) \rightarrow 1$ /* up to $\frac{m-1}{2}$ edges */

$f^*(e'_{7i-20}) = f^*(e'_{7i-18}) = f^*(e'_{7i-16}) = f^*(e'_{7i-6}) = f^*(e'_{7i-4}) = f^*(e'_{7i-2})$
$\rightarrow 1$ /* up to $\frac{3}{2}(m+1)$ edges */

$f^*(e'_{7i-13}) = f^*(e'_{7i-10}) = f^*(e'_{7i-9}) \rightarrow 1$ /* up to $\frac{3}{2}(m-1)$ edges */

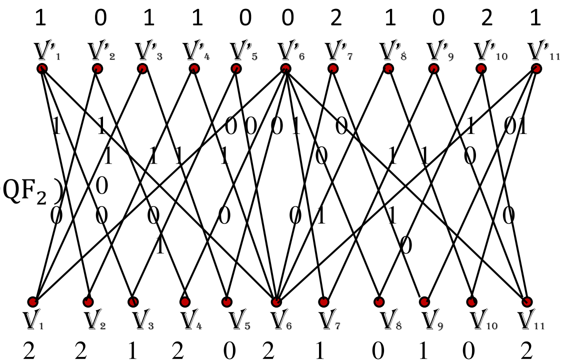
$f(e'_{7i-15}) = f^*(e'_{7i-1}) \rightarrow 1$ /* up to $\frac{m+1}{2}$ edges */

} End the processes. **Thus the 7m edges received label 1.**

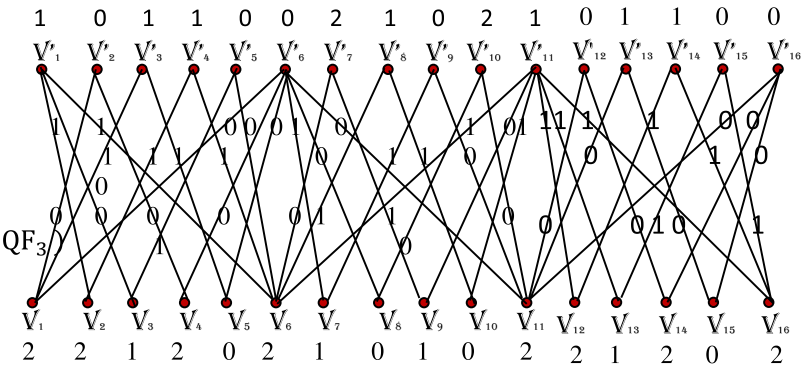
Hence, Double Quadrilateral flow graph of odd numbered paths has 14m edges received either 0 or 1.

ILLUSTRATION:

DG(DQF$_2$)



DG(DQF$_3$)



Hence the duplicate graph of the Double Quadrilateral Flow graph $DG(QF_m)$, $m \geq 2$, admits sum divisor of 3-equitable cordial labeling.

6. Conclusion

In the present paper we determine the Duplicate graph of Double Quadrilateral Flow $DG(DQF_m)$, $m \geq 2$. Cordial, Product cordial and Sum divisor of 3-equitable cordial labeling are admits.

7. References

[1]. J. A. Gallian, A Dynamic Survey of Graph Receive labeling, The Electronic Journal of Combinatorics, #DS6, (2014).

[2]. E. Sampath kumar, "On duplicate graphs", Journal of the Indian Math. Soc. 37, 285 – 293 (1973).

[3]. Cahit, On cordial and 3-equitable labelings of graphs, Util. Math., 37(1990), 189-198.

[4]. K.Thirusangu, P.P.Ulaganathan and B.Selvam, Cordial labeling in duplicate graphs, Int.J. Computer Math. Sci. Appl.4 (1-2)(2010), 179-186.

[5]. P. Vijayakumar P.P. Ulaganathan and K. Thirusangu, "Some Cordial Labeling in Extended Duplicate Graph of Star Graph", International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.80, 171 – 174, (2015).

[6]. Selvam, .B, Thirusangu. K and Ulaganathan. p. extended duplicate twig graphs ".International Journals of Applied Engineering Research,6(8),pp.1075-1085.

[7]. E.Nanda gopal, V.Maheswari, P.Vijaya kumar "Special Type labeling for the Extended Duplicate Graph of Quadrilateral Snake Graph" International Journal of Information and Computing Science ISSN NO: 0972-1347 Vol. 2, No.59-68, (2019).

[8]. P.Indira, B.Selvam, K.Thirusangu "Total 3 - Sum Cordial And Product E- Cordial labeling For The Extended Duplicate Graph Of Quadrilateral Snake Graph", Journal of Applied Science and Computations ISSN NO: 1076-5131Vol. 6, No.476 -483, (2019).

[9]. B.Selvam, K.Anitha, and K.Thirusangu." Cordial and Product Cordial Labeling for the Extended Duplicate Graph of Kite Graph" International Journal of Mathematics and its Applications ISSN: 2347-1557 Vol.4, Issue 3{B (2016), 61{68.

[10]. Murugesan S. 3-equitable Prime cordial Labeling of Graphs, International Journal of Applied Information Systems. 2013; 5:1-4.

[11]. Sundaram M, Ponraj R,Somasundaram S. Prime cordial labeling of Graphs, Journal of Indian Academy of Mathem atics, 2005; 27:373-390.

[12]. Pb Agus Ristono*,"Design Of Reliable And Efficient Manchester Carry Chain Adder Based 8-Bit Alu For High Speed Applications",Journal Of VLSI Circuits And Systems, 1 (01), 1-4,2019

[13].NHK K. ISMAIL*,"Estimation Of Reliability Of D Flip-Flops Using Mc Analysis", Journal of VLSI Circuits And Systems 1 (01), 10-12,2019