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# Identical Product of Graphs

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***Abstract:** A new graph product called identical product is introduced in this paper.*
***Keywords:** Graph products, Identical Product*

## I. INTRODUCTION

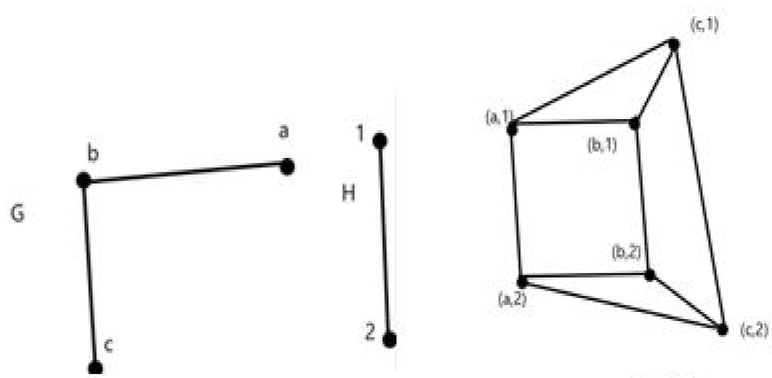
A graph[1] is an ordered triple $G = (V(G), E(G), I_G)$ where V(G) is a nonempty set E(G) is a set disjoint from V(G) and $I_G$ is an "incidence" relation that associates with each element of E(G) an unordered pair of elements (same or distinct) of V(G) . Elements of V(G) are called the vertices (or nodes or points) of G; and elements of E(G) are called the edges (or lines) of G: V(G) and E(G) are the vertex set and edge set of G, respectively. If, for the edge e of G, $I_G$(e) ={u,v} Number of vertices and the number of edges in a graph G is called the order n(G) and the size m(G) of G respectively. Number of edges incident on a vertex v of a graph G is called degree of v in G and is denoted by $d_G(v)$. A graph G is regular if degree of all vertices in G are equal. Let $G_1 = (V_1, E_1)$ and $G_2 = (V_2, E_2)$ be two simple graphs. Any product [1] $G_1 * G_2$ has its vertex set $V_1 \times V_2$. For any two vertices $(u_1, v_1)$ *and* $(u_2, v_2)$ are adjacent in $G_1 * G_2$, there are various possibilities:
$u_1$ adjacent to $v_1$ in $G_1$ or $u_1$ non-adjacent to $v_1$ in $G_1$; $u_2$ adjacent to $v_2$ in $G_2$ or $u_2$ non-adjacent to $v_2$ in $G_2$ and $u_1 = u_2$ and/or $v_1 = v_2$. Two graph products

## II. IDENTICAL PRODUCT

### *1) Definition*

Let $G_1 = (V_1, E_1)$ and $G_2 = (V_2, E_2)$ be two simple graphs. The identical product $G_1 \blacksquare G_2$ has its vertex set $V_1 \times V_2$. Any two vertices $(u_1, v_1)$ *and* $(u_2, v_2)$ are adjacent in $G_1 \blacksquare G_2$ if and only if $u_1 = u_2$ or $v_1 = v_2$.

*Example:*




$G \blacksquare H$
Figure 1

### *2) Theorem*

The identical product of any two graphs G and H with $n_1$ and $n_2$ vertices respectively

*Proof:* From the definition of the identical product, it is clear that the adjacency of two vertices in $G \blacksquare H$ will not depend on the adjacency of vertices in G or H(since $(u_1, v_1)$ *and* $(u_2, v_2)$ are adjacent in $G_1 \blacksquare G_2$ if and only if $u_1 = u_2$ or $v_1 = v_2$). Hence the theorem.

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*3) Theorem*

The number of edges in the identical product of any two graphs G and H with $n_1$ and $n_2$ vertices respectively is $\frac{n_1 n_2 (n_1+n_2-2)}{2}$

*Proof:* Let u be any vertex in graph G. Then there are $n_2$ vertices in $G\blacksquare H$ in the form (u,x) where x is any vertex in H and these vertices are adjacent to each other. Therefore, there are $\frac{n_1 n_2 (n_2-1)}{2}$ edges in this case. Also if v be any vertex in graph H, there are $n_1$ of the form (x,v) where y be any vertex in G and these vertices are adjacent to each other. Therefore, there are $\frac{n_1 n_2 (n_1-1)}{2}$ edges in this case.

Hence the total number of edges in $G\blacksquare H$ = $\frac{n_1 n_2 (n_2-1)}{2}+ + \frac{n_1 n_2 (n_1-1)}{2} = \frac{n_1 n_2 (n_1+n_2-2)}{2}$.

*4) Theorem*

Identical product of any two graphs is regular

*Proof:* Let G and H be two graphs with $n_1$ and $n_2$ vertices respectively. .Let (u,v) be any vertex in $G\blacksquare H$

$d(u,v) = n_2 - 1 + n_1 - 1 = n_2 + n_1 - 2$

Hence identical product is regular.

## III. CONCLUSIONS

In this paper the identical product of two graphs is defined and proved some results relating to this

## REFERENCES

[1] R Balakrishnan and K. Ranganathan, A text book of Graph Thoery, Second Edition, Springer[2012]
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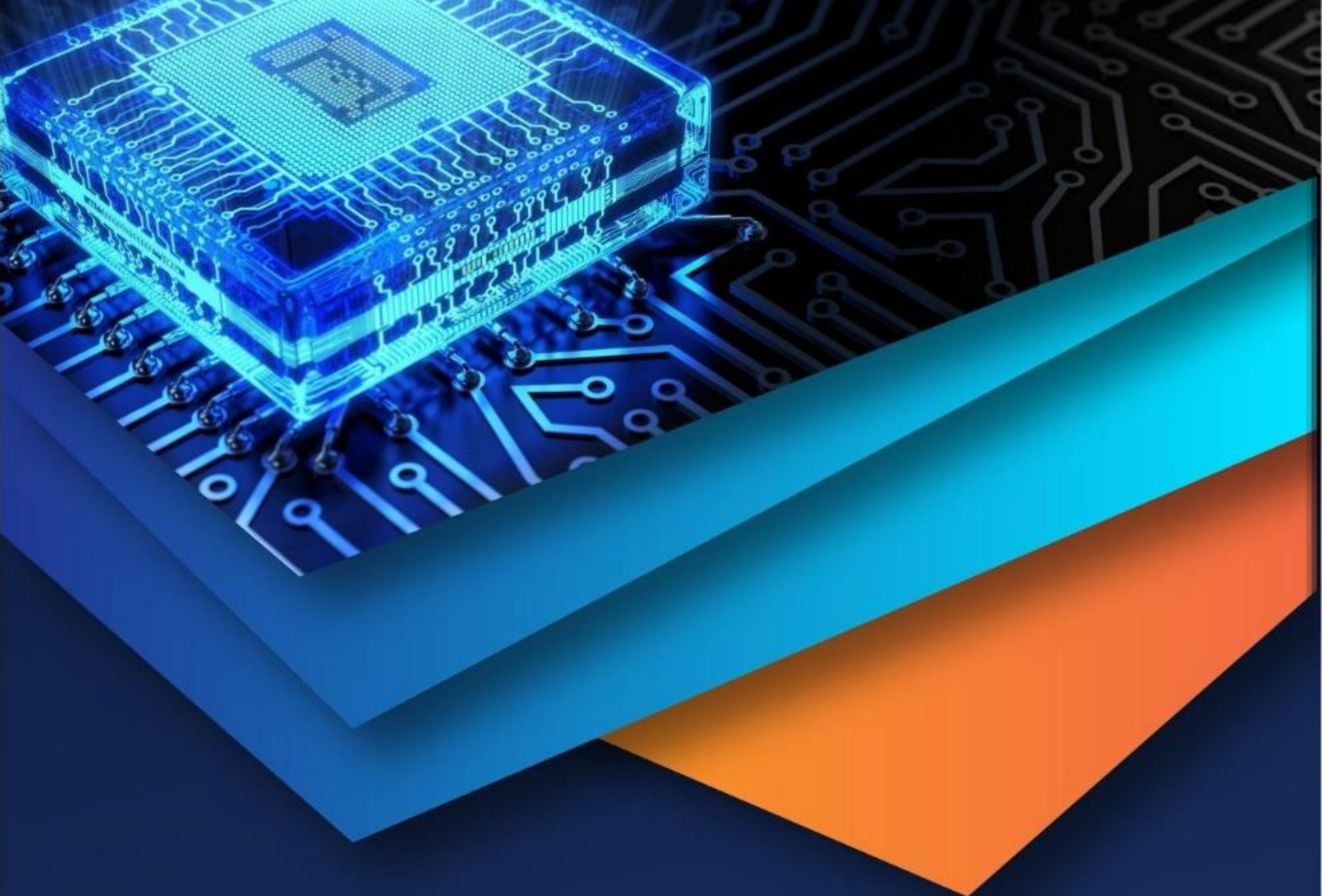


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