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Chromatic Prime Number for Circular Embedded Graph of the Tensor Product Graph

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***Abstract:** The Chromatic number of tensor product ($G \otimes H$) of G and H has vertex set V(G) and V(H). In this paper, we introduced chromatic prime number on circular embedded graph of tensor product*
***Keywords:** Circular embedded Graph, Chromatic number and Chromatic prime number. P^+ and P^- are positive and negative edge prime numbers.*

I. INTRODUCTION

In this paper, we provide few results on chromatic prime number on circular embedded of tensor product graphs for connected, butterfly and pentagon graphs. **A** graph consists of a set of vertices V(G) and a set of edges E(G). For every vertices u_1,u_2 V(G), the edge connecting u_1 and u_2 is denoted by e_1. Here, we introduced the chromatic prime number for the circular embedded graph of tensor product. We first prove that $\chi_p(G \otimes H) \leq \min\{\chi_p(G), \chi_p(H)\}$. An assignment of colors to the vertices of a graph, so that no two adjacent vertices get the same color is called a coloring of the graph. The chromatic number of a graph G is the minimum number of colors needs to color the graph G.

II. PRELIMINARIES

In this section, we introduced the chromatic prime number on tensor product graph with respect to the positive and negative prime number

Definition 1: The Tensor product, $G \otimes H$, of graph G and H is the graph with vertex set $v(G) \times v(H)$ and $(a,x)(b,y) \in E(G \otimes H)$ whenever $ab \in E(G)$ and $xy \in E(H)$.

Definition 2: The chromatic number, $\chi(G)$, of G is the smallest number n for which G has an n-coloring.

Definition 2: The chromatic prime number, $\chi_p(G)$, of G is the smallest number n_p for which G has an n_p-coloring.

III. MAIN RESULTS AND DISCUSSION

A. Theorem 1

Let G and H be the 2-prime colorable connected graph and Butterfly graph respectively, then their product satisfies the circular embedding through the tensor product, that is, $\boldsymbol{\chi_p}(G \otimes H) \leq \min\{\chi_p(G), \chi_p(H)\}$

B. Proof

Let G be a 2-prime colorable connected graph and butterfly graph with vertices u_1,u_2,u_3, and $v_1,v_2,...,v_7$ respectively.

Let the value of the vertices of graph G, $u_1,u_3 = 2$ and $u_2 = 3$. (u_1+u_2) and (u_2+u_3) are positive prime numbers

$$\chi (G)\ 2 = \chi_p(G) \tag{1}$$

Let the value of the vertices of graph H, $v_1,v_6, v_5 = 2$; $v_2,v_4,v_7 = 3$ and $v_3 = 5$. $(v_1 + v_2)$,$(v_1 + v_3)$, $(v_3 + v_6)$,$(v_3 + v_5)$,$(v_4 + v_5)$ and $(v_3 - v_2)$, $(v_3 - v_4)$, $(v_3 - v_7)$ are positive and negative prime numbers respectively.

$$\chi(H) = 3 = \chi_p(H) \tag{2}$$

Let the tensor product of G and H, $\chi_p(G \otimes H)$ which has satisfies the circular embedding. Let us denote, u_1v_i, u_2v_i,uv_i; where i = 1,2,...,7.

The tensor product $\chi_p(G \otimes H)$, which has prime numbers of vertices on addition and subtraction. We get positive and negative prime numbers.

$$\chi(H\otimes \mathbf{G}) = 2 = \chi_p(H\otimes \mathbf{G}) \tag{3}$$

From (1),(2) and (3), we get

$$\boldsymbol{\chi}(G \otimes H) \leq \min\{\chi(G), \chi(H)\}$$
$$\boldsymbol{\chi_p}(G \otimes H) \leq \min\{\chi_p(G), \chi_p(H)\}$$

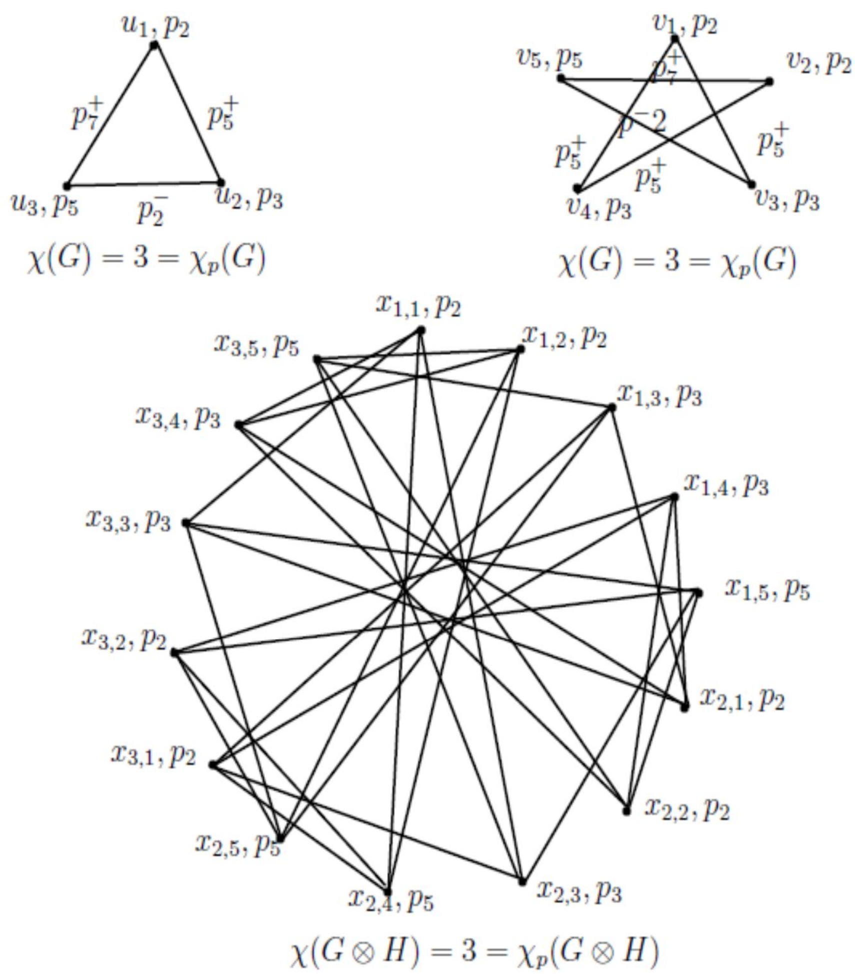

Fig. 1

C. Example

1) Theorem 2: Let G and H be the 3-prime colourable complete graph and star graph respectively, then their product satisfies the circular embedding through the tensor product, ie, $\boldsymbol{\chi_p}(G \otimes H) \leq \min\{\chi_p(G), \chi_p(H)\}$
2) *Proof:* Let G be a 3-prime colourable complete graph with vertices u_1 , u_2 and u_3. Let H be a star graph with vertices v_1 ,v_2, v_3, v_4 and v_5.

Let the value of the vertices of graph G, $u_1 = 2$, $u_2 = 3$, and $u_3 = 5$. ($u_1 + u_2$), ($u_1 + u_3$) and ($u_3 - u_2$) are positive and negative prime numbers respectively.

$$\chi(G) = 3 = \chi_p(G) \qquad (1)$$

Let the value of the vertices of graph H, v_1, $v_2 = 2$; v_3, $v_4 = 3$ and $v_5 = 5$; ($v_1 + v_3$),($v_1 + v_4$), ($v_2 + v_4$), ($v_2 + v_5$), ($v_3 + v_1$) and ($v_5 - v_3$) are positive and negative prime numbers respectively.

$$\chi(H) = 3 = \chi_p(H) \qquad (2)$$

The tensor product $\chi_p(G \otimes H)$, which satisfies the circular embedding; u_1v_i , u_2v_i , u_3v_i, where i = 1,2,...,5. The tensor product $\chi_p(G \otimes H)$, which has prime numbers of vertices on addition and subtraction, we get positive and negative prime numbers.

$$\chi(G \otimes H) = 3 \text{ therefore } \chi_p(G \otimes H) = 3 \qquad (3)$$

From (1),(2) and (3), we get

$$\boldsymbol{\chi}(G \otimes H) \leq \min\{\chi(G), \chi(H)\}$$
$$\boldsymbol{\chi_p}(G \otimes H) \leq \min\{\chi_p(G), \chi_p(H)\}$$

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D. Example

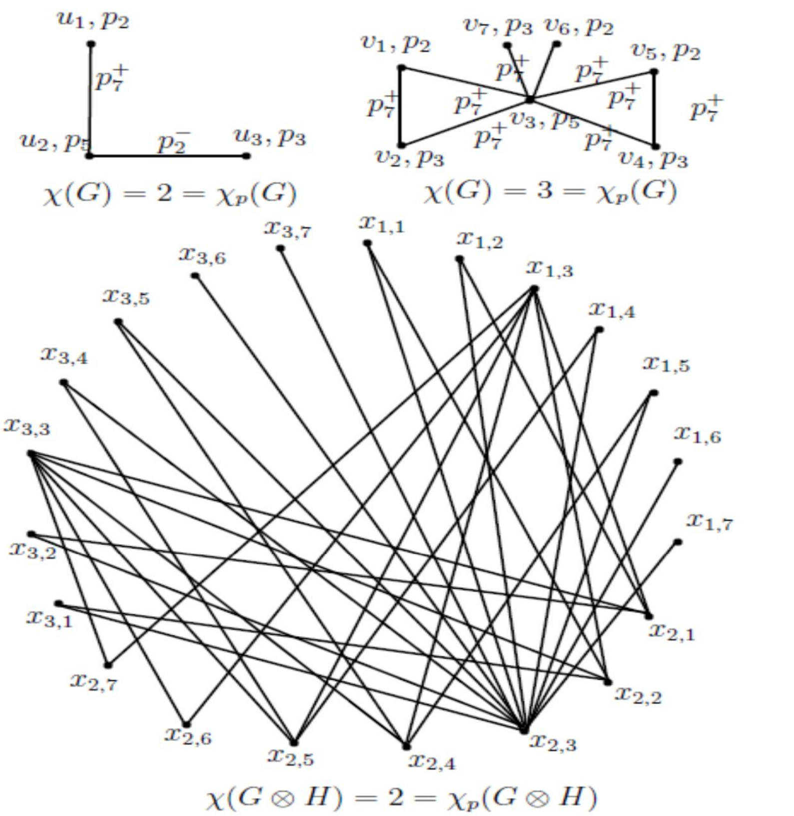

Fig. 2

1) *Theorem 3:* Let G and H be the pentagon graph and 3-prime colourable complete graph respectively, then their product satisfies the circular embedding by the tensor product,
2) *Proof:* similarly to the above theorem.
3) *Theorem 4:* Let G and H be Hexagon graph and merge graph respectively, this product satisfies the circular embedding by the tensor product, then does not exit.

Proof: Let G and H be a 2-prime colorable hexagon graph and 3-prime colorable merge graph with vertices u_1,u_2,u_3,u_4,u_5. and $v_1,v_2,\ldots,v_6$ respectively. Let the value of the vertices of graph G, $u_1,u_3,u_5 = 2$ and $u_2,u_4,u_6 = 3$. (u_1+u_2), (u_2+u_3), (u_3+u_4), (u_4+u_5), (u_5+u_6) and (u_6+u_1) are positive prime numbers and their

$$\chi(G) = 2 \text{ and } \chi_p(G) = 2. \qquad (1)$$

Let the value of the vertices of graph H, $v_1,v_3, v_6 = 2$; $v_2,v_5 = 3$ and $v_4 = 5$. $(v_1 + v_4)$, $(v_3 + v_4)$, $(v_4 + v_6)$, $(v_5 + v_6)$ and $(v_4 - v_2)$, $(v_4 - v_6)$ are positive and negative prime numbers respectively.

$$\chi(H) = 3 \text{ and their } \chi_p(H) = 3 \qquad (2)$$

Let the tensor product of G and H, $\chi_p(G \otimes H)$ which has satisfies the circular embedding.
Let us assign the values, the tensor product of the vertices uivj, where i,j = 1,2,...,6
The tensor product $\chi_p(G \otimes H)$, which has prime number of vertices on addition and subtraction, we get positive and negative prime numbers.

$$\chi_p(G \otimes H) = 3 \text{ and } \chi_p(G \otimes H) = 3 \qquad (3)$$

But χ_p (G H) = 3 is not possible by the definition of chromatic prime number.
From (1), (2) and (3) we get

$$\chi(G \otimes H) \leq \min\{\chi(G), \chi(H)\}$$
$$\chi_p(G \otimes H) \leq \min\{\chi_p(G), \chi_p(H)\}$$

IV. CONCLUSION

In this paper, we observed that the circular embedding by the tensor product graph does not possess prime chromatic number for all size and order.

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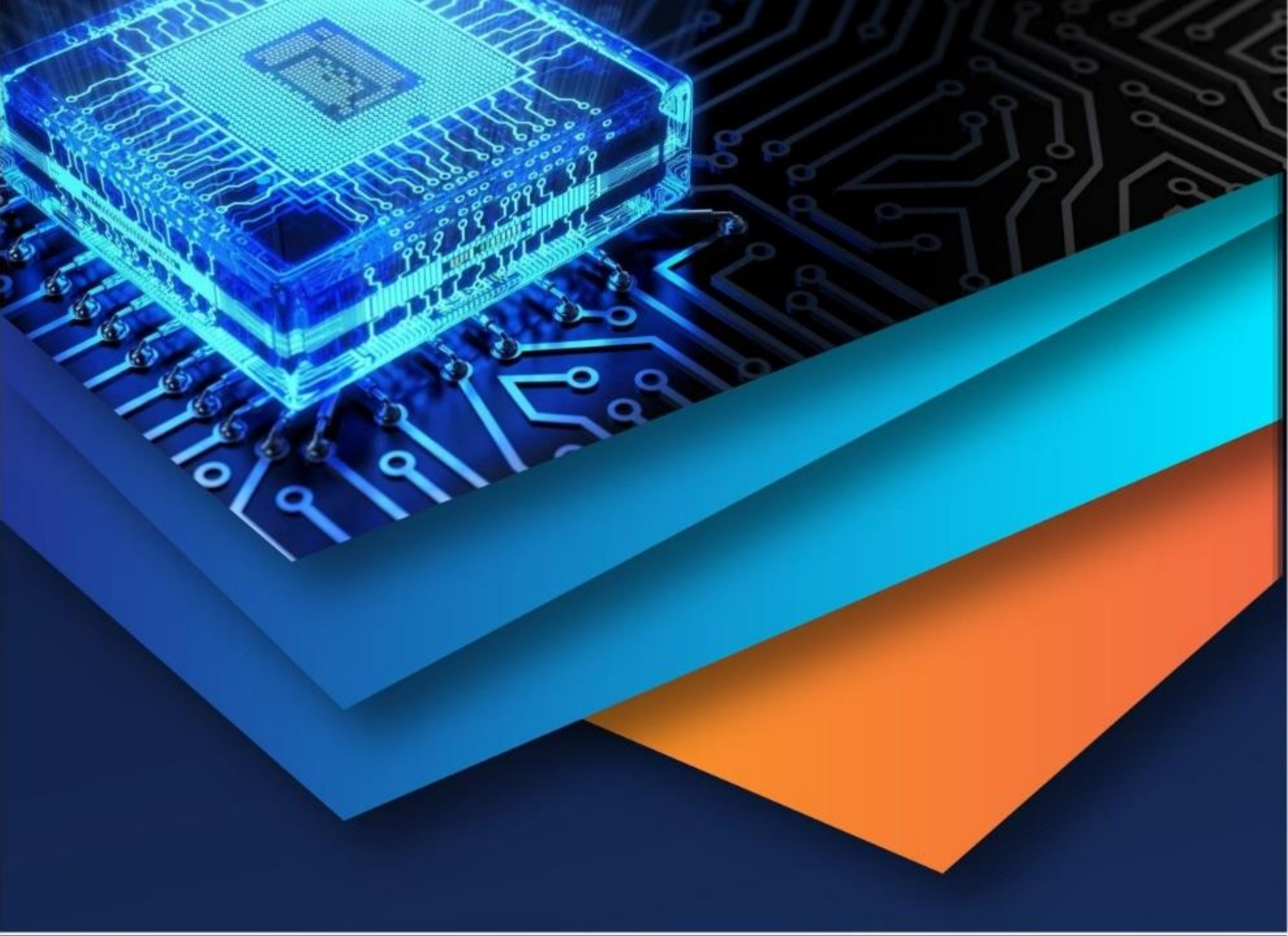

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