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DOMINATING ENERGY IN SOMEPRODUCTS OF INTUITIONISTIC FUZZY GRAPHS

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***ABSTRACT*:**The concept of energy of an Intuitionistic Fuzzy Graph is extended to dominating Energy in various products in Intuitionistic Fuzzy Graph. In this paper, We have obtained the value of dominating Energy in different products such as αproduct ,β Product, and γ Product between two intuitionistic Fuzzy graphs. Also we study the relation between the dominating Energy in the various products in two Intuitionistic Fuzzy Graphs.

***Keywords*:**-Intuitionistic fuzzy Graph, αproduct ,β Product, and γ Product of two intuitionistic fuzzy Graphs.

1. INTRODUCTION

It is quite well known that graphs are simply models of relations. A graph is a convenient way of representing information involving relationship between objects. The objects are represented by vertices and relations by edges. When there is vagueness in the description of the objects or in its relationships or in both, it is natural that we need to design a 'Fuzzy Graph Model'. Fuzzy graph is a symmetric binary fuzzy relation on a fuzzy subset. The concept of fuzzy sets and fuzzy relations was introduced by L.A.Zadeh in 1965 [15] and further studied in [2]. It was Rosenfeld [11] who considered fuzzy relations on fuzzy sets and developed the theory of fuzzy graphs in 1975.

Atanassov [2]introduced the concept of intuitionistic fuzzy relation and intuitionistic fuzzy graphs(IFG).Recent on the theory of intuitionistic fuzzy sets (IFS) has been witnessing an exponential growth of mathematics and its applications. Graph spectrum seems in problems in Statistical physics and in combinatorial optimization problems in mathematics. Spectrum of a graph also shows an important role in pattern recognition, modelling virus propagation in computer networks and in securing personal data in databases. A concept related to the spectrum of a graph is that of energy.

Let d_i be the degree of i^{th} vertex of G, i =1,2,...,n. The spectrum of the graph G, consisting of the numbers $\lambda_1, \lambda_2, ..., \lambda_n$ is the spectrum of its adjacency matrix [5]. In 1960, the study of domination in graphs was begun. In 1862, C.F. De Jaenisch [4] attempted to determine the minimum number of queens required to cover a $n \times n$ chess board. Cockayne [3] introduced the independent domination number in graphs. Domination in graphs has applications to several fields. A. Somasundaram and S. Somasundaram [12] introduced domination in fuzzy graphs in terms of effective edges. A. Nagoorgani and V.T. Chandrasekaran [6] presented domination using strong arcs. R. Parvathi and G. Thamizhendhi [8] was introduced dominating set, domination number, independent set, total dominating and total domination number in intuitionistic fuzzy graphs. Study on domination concepts in intuitionistic fuzzy graphs are more convenient that fuzzy graphs, which is useful in the traffic density and telecommunication systems.In[14], Vijayragavan et al developed the dominating energy in products of Intuitionistic fuzzy graphs.

This paper is organized as follows. In section 2, we defined the dominating energy of some special products of an intuitionistic fuzzy graphs and in section 3, we give the conclusion.

2. Dominating Energy in Some Special Products of intuitionistic fuzzy Graphs

2.1. Dominating Energy in α-Product of an intuitionistic fuzzy Graph

Definitions 2.1.1: - α-Product:-

The α –product of two Intuitionistic fuzzy graphs $G_1=(V_1,E_1)$ and $G_2=(V_2,E_2)$ denoted by $G_1 \square G_2$ is an Intuitionistic fuzzy graphs G=(V,E,$\langle \mu_r, \nu_r \rangle$,$\langle \mu_{rs}, \nu_{rs} \rangle$)

Where 1.V= $v_i u_p$ for all $v_i \in V_1$ and $u_p \in V_2$, $V_1 \cap V_2 = \phi$,i=1,2,…….,m, p=1,2,………,n.

2. E= $\langle v_i u_p, v_j u_q \rangle$, such that either one of the following is true:

- $(v_i, v_j) \in E_1$ and $(u_p, u_q) \notin E_2$

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- $(u_p, u_q) \in E_2$ and $(v_i, v_j) \notin E_1$

3. $\langle \mu_r, v_r \rangle$ denote the degrees of membership and non-membership of vertices of G, and is given by $\langle \mu_r, v_r \rangle = \langle \min(\mu_i, \mu_p), \max(v_i, v_p) \rangle$ for all $v_r \in$ V, r =1,2,3,……..,m,n.

4. $\langle \mu_{rs}, v_{rs} \rangle$ denote the degrees of membership and non-membership of edges of G, and is given by

$$\langle \mu_{rs}, v_{rs} \rangle = \begin{cases} \langle \min(\mu_i, v_j, \mu_p, \mu_q), \max(v_i, v_j, v_p, v_q) \rangle & if\,(v_i, v_j) \notin E_1 and\,(u_p, u_q) \in E_2 \\ \langle \min(\mu_p, \mu_q, \mu_{ij}), \max(v_p, v_q, v_{ij}) \rangle & if\,(v_i, v_j) \in E_1 and\,(u_p, u_q) \notin E_2 \\ \langle 0, 0 \rangle & if\,(v_i, v_j) \in E_1 and\,(u_p, u_q) \in E_2 \end{cases}$$

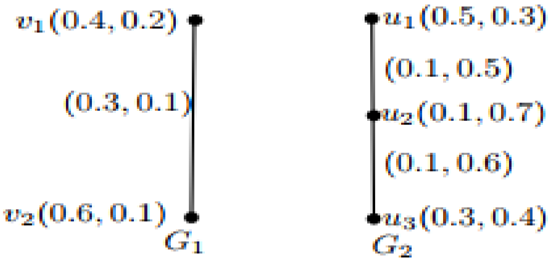

FIGURE 1.

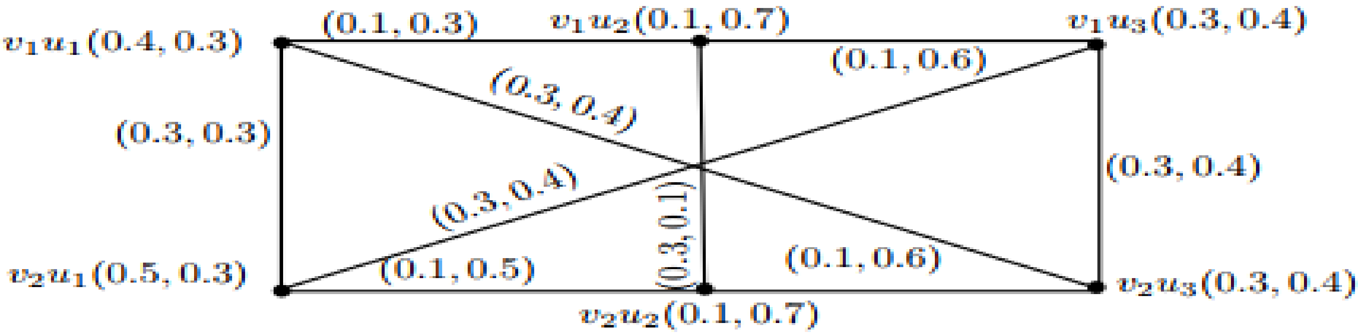

FIGURE2: $G_1 \odot G_2$

2.1.2:-Now we find the Dominating Energy of Intuitionistic fuzzy GraphG_1 G_2 (V,E)

$\mu_1(v_1u_1) = \max[\mu(v_1u_1, v_1u_2), \mu(v_1u_1, v_2u_3), \mu(v_1u_1, v_2u_1)] = \max[0.1, 0.3, 0.3] = 0.3$

$\mu_1(v_1u_2) = \max[\mu(v_1u_2, v_1u_3), \mu(v_1u_2, v_2u_2), \mu(v_1u_2, v_1u_1)] = \max[0.1, 0.3, 0.1] = 0.3$

$\mu_1(v_1u_3) = \max[\mu(v_1u_3, v_2u_3), \mu(v_1u_3, v_2u_1), \mu(v_1u_3, v_1u_2)] = \max[0.3, 0.3, 0.1] = 0.3$

$\mu_1(v_2u_1) = \max[\mu(v_2u_1, v_1u_1), \mu(v_2u_1, v_1u_3), \mu(v_2u_1, v_2u_2)] = \max[0.3, 0.3, 0.1] = 0.3$

$\mu_1(v_2u_2) = \max[\mu(v_2u_2, v_2u_1), \mu(v_2u_2, v_1u_2), \mu(v_2u_2, v_2u_3)] = \max[0.1, 0.3, 0.1] = 0.3$

$\mu_1(v_2u_3) = \max[\mu(v_2u_3, v_1u_3), \mu(v_2u_3, v_1u_1), \mu(v_2u_3, v_2u_2)] = \max[0.3, 0.3, 0.1] = 0.3$

$\gamma_1(v_1u_1) = \min[\gamma(v_1u_1, v_1u_2), \gamma(v_1u_1, v_2u_3), \gamma(v_1u_1, v_2u_1)] = \min[0.3, 0.4, 0.3] = 0.3$

$\gamma_1(v_1u_2) = \min[\gamma(v_1u_2, v_1u_3), \gamma(v_1u_2, v_2u_2), \gamma(v_1u_2, v_1u_1)] = \min[0.6, 0.1, 0.3] = 0.1$

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$\gamma_1(v_1u_3)=\min[\gamma(v_1u_3,v_2u_3),\gamma(v_1u_3,v_2u_1),\gamma(v_1u_3,v_1u_2)]=\min[0.4,0.4,0.6]=0.4$

$\gamma_1(v_2u_1)=\min[\gamma(v_2u_1,v_1u_1),\gamma(v_2u_1,v_1u_3),\gamma(v_2u_1,v_2u_2)]=\min[0.3,0.4,0.5]=0.3$

$\gamma_1(v_2u_2)=\min[\gamma(v_2u_2,v_2u_1),\gamma(v_2u_2,v_1u_2),\gamma(v_2u_2,v_2u_3)]=\min[0.5,0.1,0.6]=0.1$

$\gamma_1(v_2u_3)=\min[\gamma(v_2u_3,v_1u_3),\gamma(v_2u_3,v_1u_1),\gamma(v_2u_3,v_2u_2)]=\min[0.4,0.4,0.6]=0.4$

Here v_1u_1 is dominates v_1u_2 because

$\mu(v_1u_1,v_1u_2)\le\mu_1(v_1u_1)\wedge\mu_1(v_1u_2)$ $\gamma(v_1u_1,v_1u_2)\le\gamma_1(v_1u_1)\wedge\gamma_1(v_1u_2)$
$0.1\le 0.3\wedge 0.3$ $0.3\le 0.3\wedge 0.1$

Here v_1u_2 is dominates v_2u_2 because

$\mu(v_1u_2,v_2u_2)\le\mu_1(v_1u_2)\wedge\mu_1(v_2u_2)$ $\gamma(v_1u_2,v_2u_2)\le\gamma_1(v_1u_2)\wedge\gamma_1(v_2u_2)$
$0.3\le 0.3\wedge 0.3$ $0.1\le 0.1\wedge 0.1$

Here v_1u_3 is dominates v_2u_3 because

$\mu(v_1u_3,v_2u_3)\le\mu_1(v_1u_3)\wedge\mu_1(v_2u_3)$ $\gamma(v_1u_3,v_2u_3)\le\gamma_1(v_1u_3)\wedge\gamma_1(v_2u_3)$
$0.3\le 0.3\wedge 0.3$ $0.4\le 0.4\wedge 0.4$

Here v_2u_1 is dominates v_1u_1 because

$\mu(v_2u_1,v_1u_1)\le\mu_1(v_2u_1)\wedge\mu_1(v_1u_1)$ $\gamma(v_2u_1,v_1u_1)\le\gamma_1(v_2u_1)\wedge\gamma_1(v_1u_1)$
$0.3\le 0.3\wedge 0.3$ $0.3\le 0.3\wedge 0.3$

Here v_2u_3 is dominates v_1u_1 because

$\mu(v_2u_3,v_1u_1)\le\mu_1(v_2u_3)\wedge\mu_1(v_1u_1)$ $\gamma(v_2u_3,v_1u_1)\le\gamma_1(v_2u_3)\wedge\gamma_1(v_1u_1)$
$0.3\le 0.3\wedge 0.3$ $0.4\le 0.4\wedge 0.3$

Here V=$\{v_1u_1,v_1u_2,v_1u_3,v_2u_1,v_2u_2,v_2u_3\}$ and D=$\{v_1u_1,v_1u_2,v_1u_3,v_2u_1,v_2u_3\}$

$\therefore$ V-D $=\{v_2u_2\}$

$|D|$ =5=Sum of dominating elements.

$$D(G)=\begin{bmatrix}(1,1)&(0.1,0.3)&(0,0)&(0.3,0.3)&(0,0)&(0.3,0,4)\\(0.1,0.3)&(1,1)&(0.1,0.6)&(0,0)&(0.3,0.1)&(0,0)\\(0,0)&(0.1,0.6)&(1,1)&(0.3,0.4)&(0,0)&(0.3,0.4)\\(0.3,0.3)&(0,0)&(0.3,0.4)&(1,1)&(0.1,0.5)&(0,0)\\(0,0)&(0.3,0.1)&(0,0)&(0.1,0.5)&(0,0)&(0.1,0.6)\\(0.3,0.4)&(0,0)&(0.3,0.4)&(0,0)&(0.1,0.6)&(1,1)\end{bmatrix}$$

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$$\mu_D(G) = \begin{bmatrix} 1 & 0.1 & 0 & 0.3 & 0 & 0.3 \\ 0.1 & 1 & 0.1 & 0 & 0.3 & 0 \\ 0 & 0.1 & 1 & 0.3 & 0 & 0.3 \\ 0.3 & 0 & 0.3 & 1 & 0.1 & 0 \\ 0 & 0.3 & 0 & 0.1 & 0 & 0.1 \\ 0.3 & 0 & 0.3 & 0 & 0.1 & 1 \end{bmatrix} \quad \gamma_D(G) = \begin{bmatrix} 1 & 0.3 & 0 & 0.3 & 0 & 0.4 \\ 0.3 & 1 & 0.6 & 0 & 0.1 & 0 \\ 0 & 0.6 & 1 & 0.4 & 0 & 0.4 \\ 0.3 & 0 & 0.4 & 1 & 0.5 & 0 \\ 0 & 0.1 & 0 & 0.5 & 0 & 0.6 \\ 0.4 & 0 & 0.4 & 0 & 0.6 & 1 \end{bmatrix}$$

Eigen values of μ_D (G) = {-0.1154, 0.4219, 1.0000, 1.0000, 1.0630, 1.6306}=5.2309

Eigen values of γ_D (G)={-0.5755,0.2968,0.9178,1.0173,1.2283,2.1153}=6.151

= {5.2309, 6.151}

2.2. Dominating Energy in β-Product of an intuitionistic fuzzy Graph

Definitions 2.2.1: -β-Product:-

The β –product of two Intuitionistic fuzzy graphs $G_1=(V_1,E_1)$ and $G_2=(V_2,E_2)$ denoted by $G_1 * G_2$ is an Intuitionistic fuzzy graphs $G=(V,E,\langle \mu_r, v_r \rangle, \langle \mu_{rs}, v_{rs} \rangle)$

Where

1.V= $v_i u_p$ for all $v_i \in V_1$ and $u_p \in V_2$,$V_1 \cap V_2 = \phi$,i=1,2,…….,m, p=1,2,………,n.

2. E= $\langle v_i u_p, v_j u_q \rangle$, such that either one of the following is true:

- $(v_i, v_j) \in E_1$, when p$\neq$ q, i$\neq$ j
- $(u_p, u_q) \in E_2$, when i$\neq$ j,p$\neq$ q

3. $\langle \mu_r, v_r \rangle$ denote the degrees of membership and non-membership of vertices of G, and is given by $\langle \mu_r, v_r \rangle = \langle \min(\mu_i, \mu_p), \max(v_i, v_p) \rangle$ for all $v_r \in$ V, r =1,2,3,……..,m,n.

4. $\langle \mu_{rs}, v_{rs} \rangle$ denote the degrees of membership and non-membership of edges of G, and is given by

$$\langle \mu_{rs}, v_{rs} \rangle = \begin{cases} \langle \min(\mu_i, \mu_j, \mu_{pq}), \max(v_i, v_j, v_{pq}) \rangle & if i \neq j, (v_i, v_j) \notin E_1 and (u_p, u_q) \in E_2 \\ \langle \min(\mu_p, \mu_q, \mu_{ij}), \max(v_p, v_q, v_{ij}) \rangle & if p \neq q, (u_p, u_q) \notin E_2 and (v_i, v_j) \in E_1 \\ \langle \min(\mu_{ij}, \mu_{pq}), \max(v_{ij}, v_{pq}) \rangle & if i \neq j, p \neq q, (v_i, v_j) \in E_1 and (u_p, u_q) \in E_2 \\ \langle 0, 0 \rangle & otherwise \end{cases}$$

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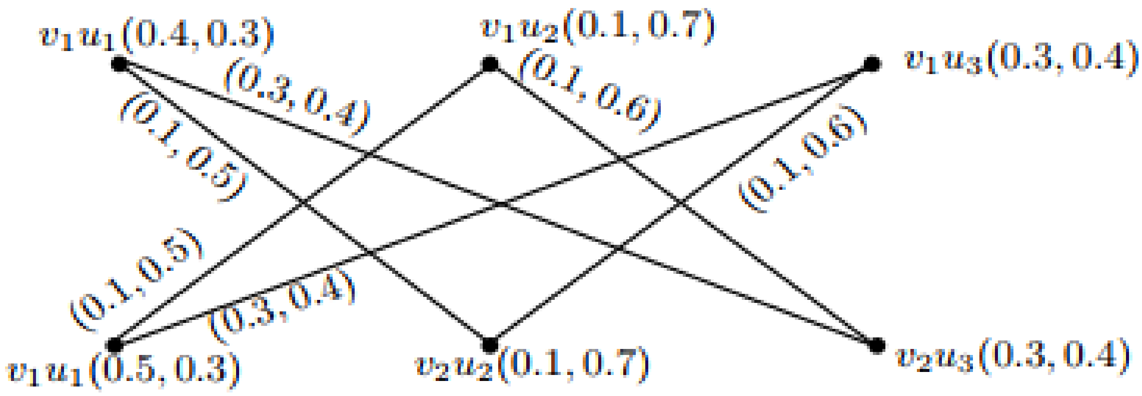

FIGURE 3: $G_1 * G_2$

2.2.2:-Now we find the Dominating Energy of Intuitionistic fuzzy Graph $G_1 * G_2$ (V,E)

$\mu_1(v_1u_1) = \max[\mu(v_1u_1, v_2u_2), \mu(v_1u_1, v_2u_3)] = \max[0.1, 0.3] = 0.3$

$\mu_1(v_1u_2) = \max[\mu(v_1u_2, v_2u_1), \mu(v_1u_2, v_2u_3)] = \max[0.1, 0.1] = 0.1$

$\mu_1(v_1u_3) = \max[\mu(v_1u_3, v_2u_1), \mu(v_1u_3, v_2u_2)] = \max[0.3, 0.1] = 0.3$

$\mu_1(v_2u_1) = \max[\mu(v_2u_1, v_1u_2), \mu(v_2u_1, v_1u_3)] = \max[0.1, 0.3] = 0.3$

$\mu_1(v_2u_2) = \max[\mu(v_2u_2, v_1u_1), \mu(v_2u_2, v_1u_3)] = \max[0.1, 0.1] = 0.1$

$\mu_1(v_2u_3) = \max[\mu(v_2u_3, v_1u_1), \mu(v_2u_3, v_1u_2)] = \max[0.3, 0.1] = 0.3$

$\gamma_1(v_1u_1) = \min[\gamma(v_1u_1, v_2u_2), \gamma(v_1u_1, v_2u_3)] = \min[0.5, 0.4] = 0.4$

$\gamma_1(v_1u_2) = \min[\gamma(v_1u_2, v_2u_1), \gamma(v_1u_2, v_2u_3)] = \min[0.5, 0.6] = 0.5$

$\gamma_1(v_1u_3) = \min[\gamma(v_1u_3, v_2u_1), \gamma(v_1u_3, v_2u_2)] = \min[0.4, 0.6] = 0.4$

$\gamma_1(v_2u_1) = \min[\gamma(v_2u_1, v_1u_2), \gamma(v_2u_1, v_1u_3)] = \min[0.5, 0.4] = 0.4$

$\gamma_1(v_2u_2) = \min[\gamma(v_2u_2, v_1u_1), \gamma(v_2u_2, v_1u_3)] = \min[0.5, 0.6] = 0.5$

$\gamma_1(v_2u_3) = \min[\gamma(v_2u_3, v_1u_1), \gamma(v_2u_3, v_1u_2)] = \min[0.4, 0.6] = 0.4$

Here v_1u_1 is dominates v_2u_2 because.

$\mu(v_1u_1, v_2u_2) \le \mu_1(v_1u_1) \wedge \mu_1(v_2u_2)$
$0.1 \le 0.3 \wedge 0.1$

$\gamma(v_1u_1, v_2u_2) \le \gamma_1(v_1u_1) \wedge \gamma_1(v_2u_2)$
$0.5 \le 0.4 \wedge 0.5$

Here v_1u_2 is dominates v_2u_1 because.

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$\mu(v_1u_2, v_2u_1) \le \mu_1(v_1u_2) \wedge \mu_1(v_2u_1)$ $\gamma(v_1u_2, v_2u_1) \le \gamma_1(v_1u_2) \wedge \gamma_1(v_2u_1)$

$0.1 \le 0.1 \wedge 0.3$ $\quad$ $0.5 \le 0.5 \wedge 0.4$

Here v_1u_3 is dominates v_2u_1 because.

$\mu(v_1u_3, v_2u_1) \le \mu_1(v_1u_3) \wedge \mu_1(v_2u_1)$ $\gamma(v_1u_3, v_2u_1) \le \gamma_1(v_1u_3) \wedge \gamma_1(v_2u_1)$

$0.3 \le 0.3 \wedge 0.3$ $\quad$ $0.4 \le 0.4 \wedge 0.4$

Here v_2u_3 is dominates v_1u_1 because.

$\mu(v_2u_3, v_1u_1) \le \mu_1(v_2u_3) \wedge \mu_1(v_1u_1)$ $\gamma(v_2u_3, v_1u_1) \le \gamma_1(v_2u_3) \wedge \gamma_1(v_1u_1)$

$0.3 \le 0.3 \wedge 0.3$ $\quad$ $0.4 \le 0.4 \wedge 0.4$

Here V=$\{v_1u_1, v_1u_2, v_1u_3, v_2u_1, v_2u_2, v_2u_3\}$ and D=$\{v_1u_1, v_1u_2, v_1u_3, v_2u_3\}$

$\therefore$ V-D $=\{v_2u_1, v_2u_2\}$

$|D|$ =4=Sum of dominating elements.

$$D(G) = \begin{bmatrix} (1,1) & (0,0) & (0,0) & (0,0) & (0.1,0.5) & (0.3,0.4) \\ (0,0) & (1,1) & (0,0) & (0.1,0.5) & (0,0) & (0.1,0.6) \\ (0,0) & (0,0) & (1,1) & (0.3,0.4) & (0.1,0.6) & (0,0) \\ (0,0) & (0.1,0.5) & (0.3,0.4) & (0,0) & (0,0) & (0,0) \\ (0.1,0.5) & (0,0) & (0.1,0.6) & (0,0) & (0,0) & (0,0) \\ (0.3,0.4) & (0.1,0.6) & (0,0) & (0,0) & (0,0) & (1,1) \end{bmatrix}$$

$$\mu_D(G) = \begin{bmatrix} 1 & 0 & 0 & 0 & 0.1 & 0.3 \\ 0 & 1 & 0 & 0.1 & 0 & 0.1 \\ 0 & 0 & 1 & 0.3 & 0.1 & 0 \\ 0 & 0.1 & 0.3 & 0 & 0 & 0 \\ 0.1 & 0 & 0.1 & 0 & 0 & 0 \\ 0.3 & 0.1 & 0 & 0 & 0 & 1 \end{bmatrix} \quad \gamma_D(G) = \begin{bmatrix} 1 & 0 & 0 & 0 & 0.5 & 0.4 \\ 0 & 1 & 0 & 0.5 & 0 & 0.6 \\ 0 & 0 & 1 & 0.4 & 0.6 & 0 \\ 0 & 0.5 & 0.4 & 0 & 0 & 0 \\ 0.5 & 0 & 0.6 & 0 & 0 & 0 \\ 0.4 & 0.6 & 0 & 0 & 0 & 1 \end{bmatrix}$$

Eigen values of μ_D (G) = {-0.1003,-0.0106, 0.6901, 1.0034, 1.0969, 1.3205}=4.2218

Eigen values of γ_D(G) = {-0.5397,-0.2185, 0.3911, 1.1609, 1.3788, 1.8274}=5.5164

2.3. Dominating Energy in γ-Product of an intuitionistic fuzzy Graph

Definitions 2.3.1: -γ -Product:-

The γ –product of two Intuitionistic fuzzy graphs G$_1$=(V$_1$,E$_1$) and G$_2$=(V$_2$,E$_2$) denoted by G$_1$⊡G$_2$is an Intuitionistic fuzzy graphs G=(V,E,$\langle \mu_r, v_r \rangle$,$\langle \mu_{rs}, v_{rs} \rangle$)

Where

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1.V= $v_i u_p$ for all $v_i \in V_1$ and $u_p \in V_2$, $V_1 \cap V_2 = \phi$, i=1,2,.......,m, p=1,2,.........,n.

2. E= $\langle v_i u_p, v_j u_q \rangle$, such that either $(v_i, v_j) \in E_1$ or $(u_p, u_q) \in E_2$

3. $\langle \mu_r, v_r \rangle$ denote the degrees of membership and non-membership of vertices of G, and is given by $\langle \mu_r, v_r \rangle = \langle \min(\mu_i, \mu_p), \max(v_i, v_p) \rangle$ for all $v_r \in$ V, r =1,2,3,........,m,n.

4. $\langle \mu_{rs}, v_{rs} \rangle$ denote the degrees of membership and non-membership of edges of G, and is given by

$$\langle \mu_{rs}, v_{rs} \rangle = \begin{cases} \langle \min(\mu_i, \mu_j, \mu_{pq}), \min(v_i, v_j, v_{pq}) \rangle & if\,(v_i, v_j) \notin E_1 and\,(u_p, u_q) \in E_2 \\ \langle \min(\mu_p, \mu_q, \mu_{ij}), \min(v_p, v_q, v_{ij}) \rangle & if\,(u_p, u_q) \notin E_2 and\,(v_i, v_j) \in E_1 \\ \langle \min(\mu_{ij}, \mu_{pq}), \max(v_{ij}, v_{pq}) \rangle & if\,(v_i, v_j) \in E_1 and\,(u_p, u_q) \in E_2 \\ \langle 0, 0 \rangle & otherwise \end{cases}$$

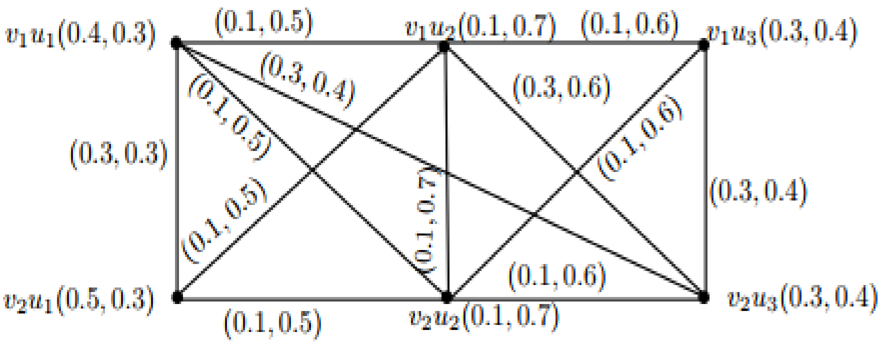

FIGURE 4: $G_1 \square G_2$

2.3.2:-Now we find the Dominating Energy of Intuitionistic fuzzy Graph $G_1 \square G_2$ (V,E)

$$\mu_1(v_1u_1) = \max[\mu(v_1u_1, v_1u_2), \mu(v_1u_1, v_2u_3), \mu(v_1u_1, v_2u_2), \mu(v_1u_1, v_2u_1)] = \max[0.1, 0.3, 0.1, 0.3] = 0.3$$

$$\begin{aligned} \mu_1(v_1u_2) &= \max[\mu(v_1u_2, v_1u_3), \mu(v_1u_2, v_2u_3), \mu(v_1u_2, v_2u_2), \mu(v_1u_2, v_2u_1), \mu(v_1u_2, v_1u_1)] \\ &= \max[0.1, 0.3, 0.1, 0.1, 0.1] = 0.3 \end{aligned}$$

$$\mu_1(v_1u_3) = \max[\mu(v_1u_3, v_2u_3), \mu(v_1u_3, v_2u_2), \mu(v_1u_3, v_1u_2)] = \max[0.3, 0.1, 0.1] = 0.3$$

$$\mu_1(v_2u_1) = \max[\mu(v_2u_1, v_1u_1), \mu(v_2u_1, v_1u_2), \mu(v_2u_1, v_2u_2)] = \max[0.3, 0.1, 0.1] = 0.3$$

$$\begin{aligned} \mu_1(v_2u_2) &= \max[\mu(v_2u_2, v_2u_1), \mu(v_2u_2, v_1u_1), \mu(v_2u_2, v_1u_2), \mu(v_2u_2, v_1u_3), \mu(v_2u_2, v_2u_3)] \\ &= \max[0.1, 0.1, 0.1, 0.1, 0.1] = 0.1 \end{aligned}$$

$$\mu_1(v_2u_3) = \max[\mu(v_2u_3, v_2u_2), \mu(v_2u_3, v_1u_1), \mu(v_2u_3, v_1u_2), \mu(v_2u_3, v_1u_3)] = \max[0.1, 0.3, 0.3, 0.3] = 0.3$$

$$\gamma_1(v_1u_1) = \min[\gamma(v_1u_1, v_1u_2), \gamma(v_1u_1, v_2u_3), \gamma(v_1u_1, v_2u_2), \gamma(v_1u_1, v_2u_1)] = \min[0.5, 0.4, 0.5, 0.3] = 0.3$$

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$$\gamma_1(v_1u_2) = \min[\gamma(v_1u_2, v_1u_3), \gamma(v_1u_2, v_2u_3), \gamma(v_1u_2, v_2u_2), \gamma(v_1u_2, v_2u_1), \gamma(v_1u_2, v_1u_1)]$$
$$= \min[0.6, 0.6, 0.7, 0.5, 0.5] = 0.5$$

$$\gamma_1(v_1u_3) = \min[\gamma(v_1u_3, v_2u_3), \gamma(v_1u_3, v_2u_2), \gamma(v_1u_3, v_1u_2)] = \min[0.4, 0.6, 0.6] = 0.4$$

$$\gamma_1(v_2u_1) = \min[\gamma(v_2u_1, v_1u_1), \gamma(v_2u_1, v_1u_2), \gamma(v_2u_1, v_2u_2)] = \min[0.3, 0.5, 0.5] = 0.3$$

$$\gamma_1(v_2u_2) = \min[\gamma(v_2u_2, v_2u_1), \gamma(v_2u_2, v_1u_1), \gamma(v_2u_2, v_1u_2), \gamma(v_2u_2, v_1u_3), \gamma(v_2u_2, v_2u_3)]$$
$$= \min[0.5, 0.5, 0.7, 0.6, 0.6] = 0.5$$

$\gamma_1(v_2u_3) = \min[\gamma(v_2u_3, v_2u_2), \gamma(v_2u_3, v_1u_1), \gamma(v_2u_3, v_1u_2), \gamma(v_2u_3, v_1u_3)] = \min[0.6, 0.4, 0.6, 0.4] = 0.4$ Here v_1u_1 is dominates v_1u_2 because.

$$\mu(v_1u_1, v_1u_2) \le \mu_1(v_1u_1) \wedge \mu_1(v_1u_2) \quad \gamma(v_1u_1, v_1u_2) \le \gamma_1(v_1u_1) \wedge \gamma_1(v_1u_2)$$
$$0.1 \le 0.3 \wedge 0.3 \quad\quad 0.5 \le 0.3 \wedge 0.5$$

Here v_1u_2 is dominates v_2u_1 because.

$$\mu(v_1u_2, v_2u_1) \le \mu_1(v_1u_2) \wedge \mu_1(v_2u_1) \quad \gamma(v_1u_2, v_2u_1) \le \gamma_1(v_1u_2) \wedge \gamma_1(v_2u_1)$$
$$0.1 \le 0.3 \wedge 0.3 \quad\quad 0.5 \le 0.5 \wedge 0.3$$

Here v_1u_3 is dominates v_2u_3 because.

$$\mu(v_1u_3, v_2u_3) \le \mu_1(v_1u_3) \wedge \mu_1(v_2u_3) \quad \gamma(v_1u_3, v_2u_3) \le \gamma_1(v_1u_3) \wedge \gamma_1(v_2u_3)$$
$$0.3 \le 0.3 \wedge 0.3 \quad\quad 0.4 \le 0.4 \wedge 0.4$$

Here v_2u_1 is dominates v_1u_1 because.

$$\mu(v_2u_1, v_1u_1) \le \mu_1(v_2u_1) \wedge \mu_1(v_1u_1) \quad \gamma(v_2u_1, v_1u_1) \le \gamma_1(v_2u_1) \wedge \gamma_1(v_1u_1)$$
$$0.3 \le 0.3 \wedge 0.3 \quad\quad 0.3 \le 0.3 \wedge 0.3$$

Here v_2u_2 is dominates v_2u_1 because.

$$\mu(v_2u_2, v_2u_1) \le \mu_1(v_2u_2) \wedge \mu_1(v_2u_1) \quad \gamma(v_2u_2, v_2u_1) \le \gamma_1(v_2u_2) \wedge \gamma_1(v_2u_1)$$
$$0.1 \le 0.1 \wedge 0.3 \quad\quad 0.5 \le 0.5 \wedge 0.3$$

Here v_2u_3 is dominates v_1u_1 because.

$$\mu(v_2u_3, v_1u_1) \le \mu_1(v_2u_3) \wedge \mu_1(v_1u_1) \quad \gamma(v_2u_3, v_1u_1) \le \gamma_1(v_2u_3) \wedge \gamma_1(v_1u_1)$$
$$0.3 \le 0.3 \wedge 0.3 \quad\quad 0.4 \le 0.4 \wedge 0.3$$

Here V={$v_1u_1, v_1u_2, v_1u_3, v_2u_1, v_2u_2, v_2u_3$}and D={ $v_1u_1, v_1u_2, v_1u_3, v_2u_1, v_2u_2, v_2u_3$}

$\therefore$ V-D = {0}

$|D|$ =6=Sum of dominating elements.

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$$D(G)=\begin{bmatrix} (1,1) & (0.1,0.5) & (0,0) & (0.3,0.3) & (0.1,0.5) & (0.3,0.4) \\ (0.1,0.5) & (1,1) & (0.1,0.6) & (0.1,0.5) & (0.1,0.7) & (0.3,0.6) \\ (0,0) & (0.1,0.6) & (1,1) & (0,0) & (0.1,0.6) & (0.3,0.4) \\ (0.3,0.3) & (0.1,0.5) & (0,0) & (1,1) & (0.1,0.5) & (0,0) \\ (0.1,0.5) & (0.1,0.7) & (0.1,0.6) & (0.1,0.5) & (1,1) & (0.1,0.6) \\ (0.3,0.4) & (0.3,0.6) & (0.3,0.4) & (0,0) & (0.1,0.6) & (1,1) \end{bmatrix}$$

$$\mu_D(G)=\begin{bmatrix} 1 & 0.1 & 0 & 0.3 & 0.1 & 0.3 \\ 0.1 & 1 & 0.1 & 0.1 & 0.1 & 0.3 \\ 0 & 0.1 & 1 & 0 & 0.1 & 0.3 \\ 0.3 & 0.1 & 0 & 1 & 0.1 & 0 \\ 0.1 & 0.1 & 0.1 & 0.1 & 1 & 0.1 \\ 0.3 & 0.3 & 0.3 & 0 & 0.1 & 1 \end{bmatrix} \quad \gamma_D(G)=\begin{bmatrix} 1 & 0.5 & 0 & 0.3 & 0.5 & 0.4 \\ 0.5 & 1 & 0.6 & 0.5 & 0.7 & 0.6 \\ 0 & 0.6 & 1 & 0 & 0.6 & 0.4 \\ 0.3 & 0.5 & 0 & 1 & 0.5 & 0 \\ 0.5 & 0.7 & 0.6 & 0.5 & 1 & 0.6 \\ 0.4 & 0.6 & 0.4 & 0 & 0.6 & 1 \end{bmatrix}$$

Eigen values of μ_D (G) = {0.4791, 0.7911, 0.8709, 0.9498, 1.1970, 1.7121}=6

Eigen values of γ_D (G) = {0.0382, 0.3000, 0.3909, 0.8736, 1.1975, 3.1998}=6

3.CONCLUSION

In this paper we have distinct the dominating intuitionistic fuzzy graph $G=(V,E,\mu,\gamma,\mu_1,\gamma_1)$ .The Dominating energyin the various products of Intuitionistic fuzzy graph is well-defined and the results with appropriate examples are inspected in detail.

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