

## Edge Irregular Pythagorean Neutrosophic Fuzzy Magic Graph

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### Article History:

*Received:10-05-2025*

*Revised:27-06-2025*

*Accepted:10-07-2025*

### Abstract:

This paper investigate several categories of edge irregular Pythagorean Neutrosophic fuzzy magic graphs(PNFMG), including neighbourly edge totally irregular, strongly edge irregular and strongly edge totally irregular Pythagorean Neutrosophic Fuzzy magic graph. These graph classes are formally defined and illustrated. In addition various structural properties of these graphs are examined. Also we demonstrate strongly edge irregularity and strongly edge totally irregularity on Path, Cycle and Star graphs.

Keywords: Edge irregular PNFMG, Neighbourly edge irregular PNFMG, Neighbourly edge totally irregular PNFMG, Strongly edge irregular PNFMG, Strongly edge totally irregular PNFMG

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### Introduction.

The concept of Pythagorean Neutrosophic Set (PNS), was the combination of Pythagorean fuzzy set and Neutrosophic fuzzy set holding constraints of truth and falsity as dependent and indeterminacy as independent constraints in which sum of square of truth membership, false membership and indeterminacy value lies between 0 and 2. The concept of fuzzy sets, introduced by Zadeh (1965)[15], has provided a powerful mathematical framework for handling uncertainty and vagueness in various real-world problems. Building upon this foundation, Rosenfeld [7] (1975) introduced the concept of fuzzy graphs. Over the years, several researchers have contributed to the enrichment of fuzzy graph theory. K. Radha and N. Kumaravel introduced the concept of edge degree, total edge degree in fuzzy graph and edge regular fuzzy graphs and investigate about edge degree in some fuzzy graphs. N. R Santhi Maheswari and C. Sekar [10] introduced the concept of edge irregular and edge totally edge irregular fuzzy graph and discussed its properties. Also they proposed the concept of neighbourly irregular and neighbourly totally irregular fuzzy graphs[9, 11]. Later, NagoorGani and Radha [4] introduced the idea of totally regular fuzzy graphs, which was followed by several generalizations to accommodate different levels of uncertainty and irregularity. S. Sivabala et.al.,[10] introduced the concept of Neighbourly and highly irregular Neutrosophic graph. S. P Nandhini et. al.,[6] defined the notion of strongly irregular interval valued fuzzy graphs.N. R Shanthi Maheshwari et. Al.,[12] examined some results on strongly edge irregular fuzzy graph. Hossein Rashmanlou et. al., [2] investigate and give more results on highly irregular interval valued fuzzy graphs. Ali Asghar Talebi et.al., [14] introduced the novel properties of Edge irregular single valued Neutrosophic Graphs. Motivated by these

developments, In this paper we introduce and investigate the concept of edge irregular Pythagorean Neutrosophic fuzzy magic graphs(PNFMG), including neighbourly edge totally irregular, strongly edge irregular and strongly edge totally irregular Pythagorean Neutrosophic Fuzzy magic graph.

## 1. Preliminaries.

### Definition 2.1

A fuzzy graph defined by  $G = (\sigma, \mu)$  is a pair of functions  $\sigma: V \rightarrow [0, 1]$  and  $\mu: V \times V \rightarrow [0, 1]$  where,  $\forall u v \in V, \mu(uv) \leq \sigma(u) \wedge \sigma(v)$

### Definition 2.2

Pythagorean Neutrosophic Fuzzy Graph (PNFG) is  $G = (V, E)$  where  $V = \{v_1, v_2, \dots, v_n\}$  such that  $\mu_1, \beta_1$  and  $\sigma_1$  from  $V$  to  $[0, 1]$  with  $0 \leq \mu_1(v_i)^2 + \beta_1(v_i)^2 + \sigma_1(v_i)^2 \leq 2 \forall v_i \in V$  signifies membership, indeterminacy and non-membership functions correspondingly and  $E \subseteq V \times V$  where  $\mu_2, \beta_2$  and  $\sigma_2$  from  $V \times V$  to  $[0, 1]$  such that

$$\mu_2(v_i v_j) \leq \mu_1(v_i) \wedge \mu_1(v_j)$$

$$\beta_2(v_i v_j) \leq \beta_1(v_i) \wedge \beta_1(v_j)$$

$$\sigma_2(v_i v_j) \leq \sigma_1(v_i) \vee \sigma_1(v_j)$$

With  $0 \leq (\mu_2(v_i v_j))^2 + (\beta_2(v_i v_j))^2 + (\sigma_2(v_i v_j))^2 \leq 2 \forall v_i v_j \in E$

### Definition 2.3

A Pythagorean Neutrosophic Fuzzy Graph  $G = (V, E)$  is said to be Pythagorean Neutrosophic Fuzzy magic graph if there exist a magic graph M such that

$\mu(v_i) + \alpha(v_i v_j) + \mu(v_j)$  having a constant value denoted by  $m$ ,

$\eta(v_i) + \beta(v_i v_j) + \eta(v_j)$  having a constant value denoted by  $m'$  and

$\delta(v_i) + \gamma(v_i v_j) + \delta(v_j)$  having a constant value denoted by  $m'' \forall v_i, v_j \in V$

We denote a Pythagorean Neutrosophic Fuzzy Magic Constant by  $M_0(G) = (m, m', m'')$

### Definition 2.4

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . The degree of an edge  $v_i, v_j$  in  $E$  is defined by  $d_G(v_i, v_j) = (d_\alpha(v_i, v_j), d_\beta(v_i, v_j), d_\gamma(v_i, v_j))$  where

$$d_\alpha(v_i, v_j) = d_\mu(v_i) + d_\mu(v_j) - 2\alpha(v_i, v_j) \quad \forall v_i, v_j \in E \text{ and } i \neq j$$

$$d_\beta(v_i, v_j) = d_\eta(v_i) + d_\eta(v_j) - 2\beta(v_i, v_j) \quad \forall v_i, v_j \in E \text{ and } i \neq j$$

$$d_\gamma(v_i, v_j) = d_\delta(v_i) + d_\delta(v_j) - 2\gamma(v_i, v_j) \quad \forall v_i, v_j \in E \text{ and } i \neq j$$

**Definition 2.5**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . The total degree of an edge  $v_i, v_j$  in  $E$  is defined by  $td_G(v_i, v_j) = (td_\alpha(v_i, v_j), td_\beta(v_i, v_j), td_\gamma(v_i, v_j))$  where

$$td_\alpha(v_i, v_j) = d_\mu(v_i) + d_\mu(v_j) - \alpha(v_i, v_j) \quad \forall v_i, v_j \in E \text{ and } i \neq j$$

$$td_\beta(v_i, v_j) = d_\eta(v_i) + d_\eta(v_j) - \beta(v_i, v_j) \quad \forall v_i, v_j \in E \text{ and } i \neq j$$

$$td_\gamma(v_i, v_j) = d_\delta(v_i) + d_\delta(v_j) - \gamma(v_i, v_j) \quad \forall v_i, v_j \in E \text{ and } i \neq j$$

**2. Edge Irregularity on PNFMG**

**Definition 3.1**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . Then  $G$  is said to be an edge irregular Pythagorean Neutrosophic Fuzzy Magic Graph if there exists atleast one edge which is adjacent to edges having distinct degrees.

**Definition 3.2**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . Then  $G$  is said to be an neighborly edge irregular Pythagorean Neutrosophic Fuzzy Magic Graph if every pair of adjacent edges have distinct degrees.

**Definition 3.3**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . Then  $G$  is said to be an neighborly edge totally irregular Pythagorean Neutrosophic Fuzzy Magic Graph if every pair of adjacent edges have distinct total degrees.

**Definition 3.4**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . Then  $G$  is said to be a highly edge irregular Pythagorean Neutrosophic Fuzzy Magic Graph if every edge in  $G$  is adjacent to edges having distinct degrees.

**Definition 3.5**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . Then  $G$  is said to be a highly edge totally irregular Pythagorean Neutrosophic Fuzzy Magic Graph if every edge in  $G$  is adjacent to edges having distinct total degrees.

**Definition 3.6**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . Then  $G$  is said to be a strongly edge irregular Pythagorean Neutrosophic Fuzzy

Magic Graph if every pair of edges having distinct degrees or no two edges have same degree.

**Example. 3.1**

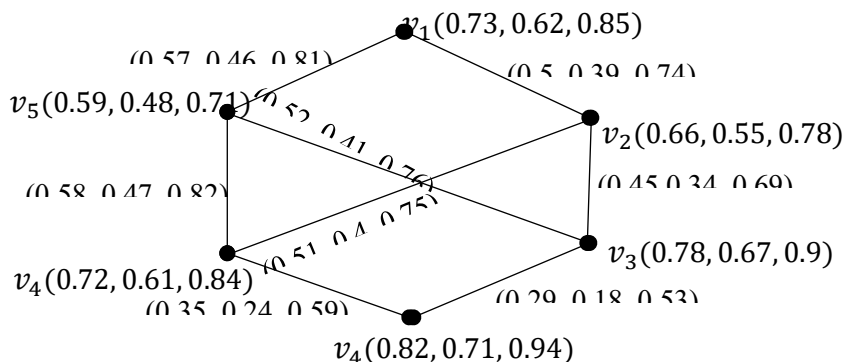


Figure. 1

In this graph ,  $d(v_1) = (1.07,0.85,1.55)$ ,  $d(v_2) = (1.46,1.13,2.18)$ ,  $d(v_3) = (1.26,0.93,1.98)$ ,  $d(v_4) = (0.64,0.42,1.12)$ ,  $d(v_5) = (1.44,1.11,2.16)$ ,  $d(v_6) = (1.67, 1.34, 2.39)$

The edge degrees are determined as follows.

$d(v_1, v_2) = (2.53, 1.2, 2.25)$ ,  $d(v_1, v_6) = (1.6, 1.27, 2.32)$ ,  $d(v_2, v_3) = (1.82,1.38,2.78)$ ,  $d(v_2v_5) = (1.88,1.44, 2.84)$ ,  $d(v_3v_4) = (1.32,0.99,2.04)$ ,  $d(v_3v_6) = (1.89, 1.45, 3.55)$ ,  $d(v_4v_5) = (1.38, 1.05, 2.8)$ ,  $d(v_5v_6) = (1.93, 1.51, 3.61)$

Here, no two edges having same degree. Hence this graph is strongly edge irregular PNFMG.

**Definition 3.7**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . Then G is said to be a strongly edge totally irregular Pythagorean Neutrosophic Fuzzy Magic Graph if every pair of edges having distinct total degrees or no two edges have same total degree.

**Example. 3.2**

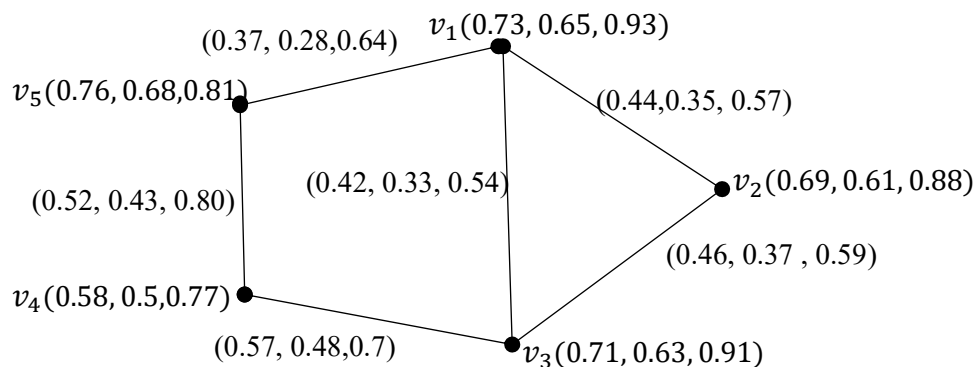


Figure. 2

In this graph ,  $d(v_1) = (1.23, 0.96, 1.75), d(v_2) = (0.9, 0.72, 1.16),$   
 $d(v_3) = (1.45, 1.18, 1.83), d(v_4) = (1.09, 0.91, 1.5), d(v_5) = (0.89, 0.71, 1.44)$

The edge total degrees are determined as follows.

$td(v_1, v_2) = (1.69, 1.33, 2.34), td(v_1, v_3) = (2.26, 1.81, 3.05),$   
 $td(v_1, v_5) = (1.75, 1.39, 2.55), td(v_2, v_3) = (1.89, 1.53, 2.4), td(v_3, v_4) = (1.97, 1.61, 2.63),$   
 $td(v_4, v_5) = (1.46, 1.19, 2.14)$

Here, no two edges having same total degrees. Hence this graph is strongly edge irregular PNFMG.

### Theorem. 3.1

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph. If  $G$  is strongly edge irregular PNFMG then  $G$  is neighborly edge irregular PNFMG.

#### Proof.

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph.

Assume that  $G$  is strongly edge irregular PNFMG. Then, Every pair of edges having distinct degrees in  $G$ .

So, every pair of adjacent edges having distinct degrees in  $G$ .

Hence  $G$  is neighborly edge irregular PNFMG

### Theorem. 3.2

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph. If  $G$  is strongly edge totally irregular PNFMG then  $G$  is neighborly edge totally irregular PNFMG.

#### Proof.

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph.

Assume that  $G$  is strongly edge totally irregular PNFMG. Then, Every pair of edges having distinct total degrees in  $G$ .

So, every pair of adjacent edges having distinct total degrees in  $G$ .

Hence  $G$  is neighborly edge totally irregular PNFMG.

### Theorem. 3.3

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph. If  $G$  is strongly edge irregular PNFMG then  $G$  is highly edge irregular PNFMG.

#### Proof.

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph.

Assume that  $G$  is strongly edge irregular PNFMG. Then, Every pair of edges having distinct degrees in  $G$ .

So, every edge is adjacent to edges with distinct degrees in  $G$ .

Hence  $G$  is highly edge irregular PNFMG

**Theorem. 3.4**

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph. If  $G$  is strongly edge totally irregular PNFMG then  $G$  is highly edge totally irregular PNFMG.

**Proof.**

Let  $G = (V, E)$  be a Pythagorean Neutrosophic Fuzzy magic graph.

Assume that  $G$  is strongly edge totally irregular PNFMG. Then, Every pair of edges having distinct total degrees in  $G$ .

So, every edge is adjacent to edges with distinct total degrees in  $G$ .

Hence  $G$  is highly edge totally irregular PNFMG

**Theorem. 3.5**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ , a path on  $2p(p > 1)$  vertices. If the degrees of truth membership, indeterminacy membership and false membership of the edges  $e_1, e_2, \dots, e_{2p-1}$  are  $x_1, x_2, \dots, x_{2p-1}$  such that  $x_1 < x_2 < \dots < x_{2p-1}$ ,  $y_1, y_2, \dots, y_{2p-1}$  such that  $y_1 < y_2 < \dots < y_{2p-1}$  and  $z_1, z_2, \dots, z_{2p-1}$  such that  $z_1 > z_2 > \dots > z_{2p-1}$  respectively. Then  $G$  is both strongly edge irregular PNFMG and Strongly edge totally irregular PNFMG.

**Proof.**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ , a path on  $2p(p > 1)$  vertices. If the edges have the different truth membership values, indeterminacy membership value and falsity membership value then,  $\alpha(e_i) = x_i$ ,  $\beta(e_i) = y_i$  and  $\gamma(e_i) = z_i$ , where  $i = 1, 2, \dots$

Let the degree of truth membership, indeterminacy and falsity-membership value of edges  $e_1, e_2, \dots, e_{2p-1}$  are  $x_1, x_2, \dots, x_{2p-1}$  such that  $x_1 < x_2 < \dots < x_{2p-1}$ ,  $y_1, y_2, \dots, y_{2p-1}$  such that  $y_1 < y_2 < \dots < y_{2p-1}$  and  $z_1, z_2, \dots, z_{2p-1}$  such that  $z_1 > z_2 > \dots > z_{2p-1}$  respectively. Then,

$$\begin{aligned}
 d_G(v_1) &= (x_1, y_1, z_1) \\
 d_G(v_2) &= (x_1 + x_2, y_1 + y_2, z_1 + z_2) \\
 &\dots\dots\dots \\
 d_G(v_{2p-1}) &= (x_{2p-2} + x_{2p-1}, y_{2p-2} + y_{2p-1}, z_{2p-2} + z_{2p-1}) \\
 d_G(v_{2p}) &= (x_{2p-1}, y_{2p-1}, z_{2p-1})
 \end{aligned}$$

Also,

$$\begin{aligned}
 d_G(e_1) &= d_G(v_1) + d_G(v_2) - 2(\alpha(v_1v_2), \beta(v_1v_2), \gamma(v_1v_2)) \\
 &= (x_1, y_1, z_1) + (x_1 + x_2, y_1 + y_2, z_1 + z_2) - 2(x_1, y_1, z_1)
 \end{aligned}$$

$$\begin{aligned}
 &= (x_2, y_2, z_2) \\
 d_G(e_2) &= d_G(v_2) + d_G(v_3) - 2(\alpha(v_2v_3), \beta(v_2v_3), \gamma(v_2v_3)) \\
 &= (x_1 + x_2, y_1 + y_2, z_1 + z_2) + (x_2 + x_3, y_2 + y_3, z_2 + z_3) - \\
 &\quad 2(x_2, y_2, z_2) \\
 &= (x_1 + x_3, y_1 + y_3, z_1 + z_3) \\
 &\dots\dots\dots \\
 d_G(e_{2p-1}) &= (x_{2p-3} + x_{2p-1}, y_{2p-3} + y_{2p-1}, z_{2p-3} + z_{2p-1}) \\
 d_G(e_{2p}) &= (x_{2p-1} + x_{2p-2} + x_{2p-1} - 2x_{2p-1}, y_{2p-1} \\
 &\quad + y_{2p-2} + y_{2p-1} - 2y_{2p-1}, z_{2p-1} + z_{2p-2} - 2z_{2p-1}) \\
 &= (x_{2p-2}, y_{2p-2}, z_{2p-2})
 \end{aligned}$$

We, observe that all the pair of edges have distinct degrees. Hence G is strongly edge irregular PNFMG

Also, we have

$$\begin{aligned}
 td_G(e_1) &= d_G(e_1) + (\alpha(v_1v_2), \beta(v_1v_2), \gamma(v_1v_2)) \\
 &= (x_2, y_2, z_2) + (x_1, y_1, z_1) \\
 &= (x_1 + x_2, y_1 + y_2, z_1 + z_2) \\
 td_G(e_2) &= d_G(e_2) + (\alpha(v_2v_3), \beta(v_2v_3), \gamma(v_2v_3)) \\
 &= (x_1 + x_3, y_1 + y_3, z_1 + z_3) + (x_2, y_2, z_2) \\
 &= (x_1 + x_2 + x_3, y_1 + y_2 + y_3, z_1 + z_2 + z_3) \\
 &\dots\dots\dots \\
 td_G(e_{2p-2}) &= (x_{2p-3} + x_{2p-1} + x_{2p-2}, y_{2p-3} + y_{2p-1} + y_{2p-2}, z_{2p-3} \\
 &\quad + z_{2p-1} + z_{2p-2}) \\
 td_G(e_{2p-1}) &= (x_{2p-1} + x_{2p-2}, y_{2p-1} + y_{2p-2}, z_{2p-1} + z_{2p-2})
 \end{aligned}$$

It is observed that any pair of edges having distinct total degrees.

Hence G is strongly edge totally irregular Pythagorean Neutrosophic Fuzzy Magic Graph.

**Theorem. 3.6**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ , a cycle on  $p(p \geq 4)$  vertices. If the degrees of truth membership, indeterminacy membership and false membership of the edges  $e_1, e_2, \dots, e_p$  are  $x_1, x_2, \dots, x_p$  such that  $x_1 < x_2 < \dots < x_p$ ,  $y_1, y_2, \dots, y_p$  such that  $y_1 < y_2 < \dots < y_p$  and  $z_1, z_2, \dots, z_p$  such that  $z_1 > z_2 > \dots > z_p$  respectively. Then G is both strongly edge irregular PNFMG and Strongly edge totally irregular PNFMG

**Proof.**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$  is an odd cycle of length  $2p + 1$ . Let the degrees degrees of truth membership, indeterminacy membership and false membership of the edges  $e_1, e_2, \dots, e_p$  are  $x_1, x_2, \dots, x_p$  such that  $x_1 < x_2 < \dots < x_p$ ,  $y_1, y_2, \dots, y_p$  such that  $y_1 < y_2 < \dots < y_p$  and  $z_1, z_2, \dots, z_p$  such that  $z_1 > z_2 > \dots > z_p$  respectively. Then

$$d_G(e_i) = (\alpha(e_i), \beta(e_i), \gamma(e_i)) = (x_i, y_i, z_i) \text{ where } i = 1, 2, \dots, p, \text{ if } p \text{ is odd}$$

$$d_G(v_1) = (x_1 + x_p, y_1 + y_p, z_1 + z_p)$$

$$d_G(v_2) = (x_1 + x_2, y_1 + y_2, z_1 + z_2)$$

.....

$$d_G(v_p) = (x_{p-1} + x_p, y_{2p-1} + y_p, z_{2p-1} + z_p)$$

Also,

$$\begin{aligned} d_G(e_1) &= d_G(v_1) + d_G(v_2) - 2(\alpha(v_1v_2), \beta(v_1v_2), \gamma(v_1v_2)) \\ &= (x_1 + x_p, y_1 + y_p, z_1 + z_p) + (x_1 + x_2, y_1 + y_2, z_1 + z_2) - 2(x_1, y_1, z_1) \end{aligned}$$

$$= (x_2 + x_p, y_2 + y_p, z_2 + z_p)$$

$$d_G(e_2) = d_G(v_2) + d_G(v_3) - 2(\alpha(v_2v_3), \beta(v_2v_3), \gamma(v_2v_3))$$

$$= (x_1 + x_2, y_1 + y_2, z_1 + z_2) + (x_2 + x_3, y_2 + y_3, z_2 + z_3) - 2(x_2, y_2, z_2)$$

$$= (x_1 + x_3, y_1 + y_3, z_1 + z_3)$$

.....

$$d_G(e_p) = d_G(v_p) + d_G(v_1) - 2(\alpha(v_p v_1), \beta(v_p v_1), \gamma(v_p v_1))$$

$$= (x_{p-1} + x_p, y_{p-1} + y_p, z_{p-1} + z_p)$$

$$+ (x_p + x_1, y_p + y_1, z_p + z_1) - 2(x_p, y_p, z_p)$$

$$= (x_{p-1} + x_1, y_{p-1} + y_1, z_{p-1} + z_1)$$

It is noted that every pair of edges having distinct degrees

Hence  $G$  is an strongly edge irregular PNFMG.

Also, we have

$$td_G(e_1) = d_G(e_1) + (\alpha(v_1v_2), \beta(v_1v_2), \gamma(v_1v_2))$$

$$= (x_2 + x_p, y_2 + y_p, z_2 + z_p) + (x_1, y_1, z_1)$$

$$\begin{aligned}
 &= (x_1 + x_2 + x_p, y_1 + y_2 + y_p, z_1 + z_2 + z_p) \\
 td_G(e_2) &= d_G(e_2) + (\alpha(v_2 v_3), \beta(v_2 v_3), \gamma(v_2 v_3)) \\
 &= (x_1 + x_3, y_1 + y_3, z_1 + z_3) + (x_2, y_2, z_2) \\
 &= (x_1 + x_2 + x_3, y_1 + y_2 + y_3, z_1 + z_2 + z_3) \\
 &\dots\dots\dots \\
 td_G(e_p) &= d_G(e_p) + (\alpha(v_p v_1), \beta(v_p v_1), \gamma(v_p v_1)) \\
 &= (x_{p-1} + x_1, y_{p-1} + y_1, z_{p-1} + z_1) + (x_p, y_p, z_p) \\
 &= (x_{p-1} + x_p + x_1, y_{p-1} + y_p + y_1, z_{p-1} + z_p + z_1)
 \end{aligned}$$

It is noted that every pair of edges having distinct total degrees.

Hence G is strongly edge totally irregular Pythagorean Neutrosophic Fuzzy Magic Graph.

**Theorem. 3.7**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ , a Star  $K_{1,p}$ . If G having the edges with distinct truth membership, indeterminacy and falsity membership values then G is a strongly edge irregular PNFMG

**Proof.**

Let  $G = (V, E)$  be a connected Pythagorean Neutrosophic Fuzzy magic graph on  $G' = (V', E')$ . If the edges have the different truth membership, indeterminacy and falsity membership value. Then

$$d_G(e_i) = (\alpha(e_i), \beta(e_i), \gamma(e_i)) = (x_i, y_i, z_i) \text{ where } i = 1, 2, \dots, p$$

Let the truth membership value, indeterminacy value and falsity membership value of edges of G be  $x_1, x_2, \dots, x_p, y_1, y_2, \dots, y_p$  and  $z_1, z_2, \dots, z_p$

$$\Rightarrow x_1 \neq x_2 \neq \dots \neq x_p, y_1 \neq y_2 \neq \dots \neq y_p \text{ and } z_1 \neq z_2 \neq \dots \neq z_p$$

Then,

$$\begin{aligned}
 d_G(v_0) &= (x_1 + x_2 + \dots + x_p, y_1 + y_2 + \dots + y_p, z_1 + z_2 + \dots + z_p) \\
 d_G(v_1) &= (x_1, y_1, z_1) \\
 d_G(v_2) &= (x_2, y_2, z_2) \\
 &\dots\dots\dots \\
 d_G(v_p) &= (x_p, y_p, z_p)
 \end{aligned}$$

Also,

$$d_G(e_1) = d_G(v_0) + d_G(v_1) - 2(\alpha(v_0 v_1), \beta(v_0 v_1), \gamma(v_0 v_1))$$

$$\begin{aligned}
 &= (x_1 + x_2 + \dots + x_p, y_1 + y_2 + \dots + y_p, z_1 + z_2 + \dots + z_p) + (x_1, y_1, z_1) - 2(x_1, y_1, z_1) \\
 &= (x_2 + x_3 + \dots + x_p, y_2 + y_3 + \dots + y_p, z_2 + z_3 + \dots + z_p) \\
 d_G(e_2) &= d_G(v_0) + d_G(v_2) - 2(\alpha(v_0v_2), \beta(v_0v_2), \gamma(v_0v_2)) \\
 &= (x_1 + x_2 + \dots + x_p, y_1 + y_2 + \dots + y_p, z_1 + z_2 + \dots + z_p) + (x_2, y_2, z_2) - 2(x_2, y_2, z_2) \\
 &= (x_1 + x_3 + \dots + x_p, y_1 + y_3 + \dots + y_p, z_1 + z_3 + \dots + z_p) \\
 &\dots\dots\dots \\
 d_G(e_p) &= d_G(v_0) + d_G(v_p) - 2(\alpha(v_0v_p), \beta(v_0v_p), \gamma(v_0v_p)) \\
 &= (x_1 + x_2 + \dots + x_p, y_1 + y_2 + \dots + y_p, z_1 + z_2 + \dots + z_p) + (x_p, y_p, z_p) - 2(x_p, y_p, z_p) \\
 &= (x_1 + x_2 + \dots + x_{p-1}, y_1 + y_2 + \dots + y_{p-1}, z_1 + z_2 + \dots + z_{p-1})
 \end{aligned}$$

Therefore all the edges having distinct degrees.

Hence G is an strongly edge irregular PNFMG.

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