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Algebraic Structure of Union of Fuzzy (Anti-Fuzzy) Normal Subgroups , Fuzzy (Anti-Fuzzy) Normal Sub – Bigroups , And Soon Fuzzy (Anti-Fuzzy) Normal Sub – N Groups .

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ABSTRACT

In this paper, union of Fuzzy subsets, definition of Fuzzy normal subgroup, definition of Fuzzy normal sub bi-group, definition of Fuzzy normal sub tri-group, definition of Fuzzy normal sub- Quadratic group, definition of fuzzy normal sub- Pentant group and definition of Fuzzy normal sub–N group are derived. Moreover, some properties and theorems of union in fuzzy normal based on these have been derived.
Keywords - Union of Fuzzy subsets, Fuzzy Normal subgroup, Fuzzy Normal sub-bigroup, Fuzzy Normal sub-trigroup , Fuzzy Normal sub – Quadratic group, Fuzzy Normal sub- Pendant group and Fuzzy Normal sub–N group.

I. INTRODUCTION

The concept of fuzzy sets was initiated by Zadeh. Then it has become a vigorous area of research in engineering, medical science, social science, graph theory etc. Rosenfeld gave the idea of fuzzy subgroups Since the paper fuzzy set theory has been considerably developed by zadeh himself and some researchers. The original concept of fuzzy sets was introduced as an extension of crisps (usual) sets, by enlarging the truth value set of "grade of members"from the two value set {0,1} to unit interval {0,1} of real numbers. The study of fuzzy group was started by Rosenfeld. It was extended by Roventa who have introduced the fuzzy groups operating on fuzzy sets. Rosenfield introduced the notion of fuzzy group and showed that many group theory results can be extended in an elementary manner to develop the theory of fuzzy group. The underlying logic of the theory of fuzzy group is to provide a strict fuzzy algebraic structure where level subset of a fuzzy group of a group G is a subgroup of the group.

The notion of bigroup was first introduced by P.L.Maggu in 1994. W.B.Vasanthakandasamy introduced fuzzy sub-bigroup with respect to +" and ."and illustrate it with example. W.B.Vasanthakandasamy was the first one to introduce the notion of bigroups in the year 1994.

II. PRELIMINARIES

In this section contain some definitions, examples and some results .

2 .1. Concept of a Fuzzy set:

The concept of a fuzzy set is an extension of the concept of a crisp set. Just as a crisp set on a universal set U is defined by its characteristic function from U to {0,1} , a fuzzy set on a domain U is defined by its membership function from U to [0,1] .

Let U be a non-empty set, to be called the **Universal set** (or) **Universe of discourse or simply a domain**. Then, by a fuzzy set of U is meant a function **A: U →[0 ,1].**

A is called **the membership function;**

A (x) is called **the membership grade** of x in A. We also write

$$A= \{(x, A (x)): x \in U\}.$$

Examples:

Consider U={a ,b ,c ,d} and A:U→**1** defined by A(a)=0,A(b)=0.7,A(c)=0.4,and A(d)=1.Then A is a fuzzy set can also be written as follows:

$$A= \{(a, 0), (b,0.7),(c,0.4),(d,1)\}.$$

2.2. Relation between Fuzzy sets:

Let U be a domain and A, B be fuzzy sets on U.

Inclusion (or) Containment: A is said to be included (or) contained in B if and only if A(x)≤B(x) for all x in U. In symbols, we write, A⊆B. We also say that A is a subset of B.

2.3 Definition

Let S be a set. A fuzzy subset A of S is a function A: S → [0,1].

2.4. Definition of Union of Fuzzy sets:

The union of two fuzzy subsets μ_1,μ_2 is defined by

$$(\mu_1 \cup \mu_2)(x) = \max\{\mu_1(x),\mu_2(x)\} \text{ for every x in U.}$$

2.5. Definition of Fuzzy Subgroup:

Let G be a group. A fuzzy subset μ of a group G is called a fuzzy subgroup of the group G if

i) $\mu(xy) \geq \min\{\mu(x),\mu(y)\}$ for every $x,y \in G$. And

ii) $\mu(x^{-1}) = \mu(x)$ for every $x \in G$.

2.6. Definition of Fuzzy Union of the fuzzy sets μ_1 and μ_2:

Let μ_1 be a fuzzy subset of a set x_1 and μ_2 be a fuzzy subset of a set x_2 , then the fuzzy union of the fuzzy sets μ_1 and μ_2 is defined as a function.

$\mu_1 \cup \mu_2 : x_1 \cup x_2 \to [0,1]$ given by

$$(\mu_1 \cup \mu_2)(x) = \begin{cases} \max(\mu_1(x),\mu_2(x)) & \text{if } x \in x_1 \cap x_2. \\ \mu_1(x) & \text{if } x \in x_1 \,\&\, x \notin x_2. \\ \mu_2(x) & \text{if } x \in x_2 \,\&\, x \notin x_1. \end{cases}$$

2.7. Definition of Fuzzy normal subgroup (Anti-Fuzzy):

Let G be a Group. A fuzzy subgroup μ of a group G is called a **Fuzzy (Anti-Fuzzy) normal subgroup** of G.

if for all x, y ∈ G,

$$\mu(xyx^{-1}) = \mu(y)$$

(or)

$$\mu(xy) = \mu(yx).$$

2.10. Definition of Fuzzy Normal Sub-bi group of the bigroup G (Anti-Fuzzy) :

Let (G,+ , .) be a bigroup with two binary operations +(addition) , . (multiplications) .Then μ : G → [0,1] is said to be a **fuzzy (Anti-Fuzzy) normal sub-bigroup of the bigroup G** under +, . , operations defined on G. if there exists two proper fuzzy subsets μ_1 of G_1 and μ_2 of G_2 such that

(i) $(\mu_1,+)$ is a fuzzy subgroup of $(G_1,+)$

(ii) $(\mu_2,.)$ is a fuzzy subgroup of $(G_2, .)$

(iii) $\mu = (\mu_1 \cup \mu_2)$.

(iv) if for all x, y ∈ G, $\mu_1(xy) = \mu_1(yx)$.

(v) if for all x, y ∈ G, $\mu_2(xy) = \mu_2(yx)$.

2.11. Definition of Fuzzy Normal Sub-tri group of the tri group G (Anti-Fuzzy) :

Let (G,+ , .,*) be a tri group with three binary operations +(addition) , . (multiplications) , * (ab/2). Then μ : G → [0,1] is said to be a **fuzzy (Anti-Fuzzy) normal sub-tri group** of the tri group G under ,+ , .,* operations defined on G. if there exists three proper fuzzy subsets μ_1 of G_1 and μ_2 of G_2, μ_3 of G_3 such that

(i) $(\mu_1,+)$ is a fuzzy subgroup of $(G_1,+)$

(ii) $(\mu_2,.)$ is afuzzy subgroup of $(G_2, .)$

(iii) $(\mu_3,*)$ is a fuzzy subgroup of $(G_3,*)$

(iv) $\mu = (\mu_1 \cup \mu_2 \cup \mu_3)$.

(v) if for all x, y $\in$ G, μ_1 (xy) = μ_1(yx).

(vi) if for all x, y $\in$ G, μ_2 (xy) = μ_2(yx).

(vii) if for all x, y $\in$ G, μ_3 (xy) = μ_3(yx).

2.18. Definition of Fuzzy Normal Sub-quadratic group of the Quadratic group G (Anti-Fuzzy) :

Let (G,+ , ·,* ,**) be a Quadratic group with Four binary operations +(addition) , . (multiplications) , * ,** . Then μ : G → [0,1] is said to be a **fuzzy normal (Anti-Fuzzy) sub- quadratic group** of the Quadratic group G under ,+ , .,*,** operations defined on G. if there exists four proper fuzzy subsets μ_1 of G_1 and μ_2 of G_2, μ_3 of G_3 ,μ_4 of G_4 such that

(i) (μ_1,+) is a fuzzy subgroup of (G_1,+)

(ii) (μ_2,.) is a fuzzy subgroup of (G_2, .)

(iii) (μ_3,*) is a fuzzy subgroup of (G_3,*)

(iv) (μ_4,**) is a fuzzy subgroup of (G_4,**)

(v) $\mu = (\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4)$.

(vi) if for all x, y $\in$ G, μ_1 (xy) = μ_1(yx).

(vii) if for all x, y $\in$ G, μ_2 (xy) = μ_2(yx).

(viii) if for all x, y $\in$ G, μ_3 (xy) = μ_3(yx).

(ix) if for all x, y $\in$ G, μ_4 (xy) = μ_4(yx).

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2.19. Definition of Fuzzy Normal Sub- pentant group of the pentant group G (Anti-Fuzzy) :

Let (G,+ , ·,* ,**,***) be a Pentant group with Five binary operations + (addition), (multiplications) , * ,**,*** . Then μ : G → [0,1] is said to be a **fuzzy normal (Anti-Fuzzy) sub - pentant group** of the Pentant group G under ,+ , .,*,** ,***,operations defined on G. if there exists five proper fuzzy subsets μ_1 of G_1 and μ_2 of G_2, μ_3 of G_3 ,μ_4 of G_4 ,μ_5 of G_5 such that

(i) (μ_1,+) is a fuzzy subgroup of (G_1,+)

(ii) (μ_2,.) is a fuzzy subgroup of (G_2, .)

(iii) (μ_3,*) is a fuzzy subgroup of (G_3,*)

(iv) (μ_4,**) is a fuzzy subgroup of (G_4,**)

(v) (μ_5,***) is a fuzzy subgroup of (G_5,***)

(vi) $\mu = (\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5)$.

(vii) if for all x, y $\in$ G, μ_1 (xy) = μ_1(yx).

(viii) if for all x, y $\in$ G, μ_2 (xy) = μ_2(yx).

(ix) if for all x, y $\in$ G, μ_3 (xy) = μ_3(yx).

(x) if for all x, y $\in$ G, μ_4 (xy) = μ_4(yx).

(xi) if for all x, y $\in$ G, μ_5 (xy) = μ_5(yx).

2.20. Definition of Fuzzy Normal Sub- n group of the n group G(Anti-Fuzzy) :

Let (G,+ , ·,* ,**,***,….,$^{(n-2)}$*) be a n group with n binary operations + (addition) , . (multiplications) , * ,**,*** ,….,$^{(n-2)}$* .
Then μ : G → [0,1] is said to be a **fuzzy (Anti-Fuzzy) normal sub – "n " group** of the n group G under ,+ , .,*,** ,***, ,….,$^{(n-2)}$* operations defined on G. if there exists n proper fuzzy subsets μ_1 of G_1 and μ_2 of G_2, μ_3 of G_3 ,μ_4 of G_4 ,μ_5 of G_5 …….,μ_n of G_n such that

(i) (μ_1,+) is a fuzzy subgroup of (G_1,+)

(ii) (μ_2,.) is a fuzzy subgroup of (G_2, .)

(iii) (μ_3,*) is a fuzzy subgroup of (G_3,*)

(iv) (μ_4,**) is a fuzzy subgroup of (G_4,**)

(v) (μ_5,***) is a fuzzy subgroup of (G_5,***)

(vi) ………………………………………….

(vii) (μ_n, $^{(n-2)}$*) is a fuzzy subgroup of (G_n,$^{(n-2)}$*)

(viii) $\mu = (\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 \ldots\ldots \cup \mu_n)$.

(ix) if for all x, y $\in$ G, μ_1 (xy) = μ_1(yx).

(x) if for all x, y $\in$ G, μ_2 (xy) = μ_2(yx).

(xi) if for all x, y $\in$ G, μ_3 (xy) = μ_3(yx).
(xii) if for all x, y $\in$ G, μ_4 (xy) = μ_4(yx).
(xiii) if for all x, y $\in$ G, μ_5 (xy) = μ_5(yx).
(xiv) ……………………………………....
(xv) ……………………………………….
(xvi) if for all x, y $\in$ G, μ_{n-1} (xy) = μ_{n-1}(yx).
(xvii) if for all x, y $\in$ G, μ_n (xy) = μ_n(yx).

III. THEOREMS

3.1. Main Theorem:

Every Fuzzy (Anti-Fuzzy) Normal Sub – bi group of a group G is a Fuzzy (Anti-Fuzzy) Normal Subgroup of the group G but not conversely .

proof:

It follows from the definition of a fuzzy (Anti-Fuzzy) normal sub – bigroup of a group G that every fuzzy (Anti-Fuzzy) normal sub – bigroup of a group G is a fuzzy (Anti-Fuzzy) normal subgroup of the group G . Converse part is not true .

3.2. Main Theorem:
Every Fuzzy (Anti-Fuzzy) Normal Sub – Tri group of a group G is a Fuzzy (Anti-Fuzzy) Normal Subgroup of the group G but not conversely .

proof:
It follows from the definition of a fuzzy (Anti-Fuzzy) normal sub – trigroup of a group G that every fuzzy (Anti-Fuzzy) normal sub – trigroup of a group G is a fuzzy (Anti-Fuzzy) normal subgroup of the group G . Converse part is not true .

3.3. Main Theorem:
Every Fuzzy (Anti-Fuzzy) Normal Sub – Quadratic group of a group G is a (Anti-Fuzzy) Fuzzy Normal Subgroup of the group G but not conversely

proof:

It follows from the definition of a fuzzy (Anti-Fuzzy) normal sub – Quadratic group of a group G that every fuzzy (Anti-Fuzzy) normal sub – Quadratic group of a group G is a fuzzy (Anti-Fuzzy) normal subgroup of the group G . Converse part is not true.

3.4. Main Theorem:
Every Fuzzy (Anti-Fuzzy) Normal Sub – Pentant group of a group G is a (Anti-Fuzzy) Fuzzy Normal Subgroup of the group G but not conversely
proof:

It follows from the definition of a fuzzy (Anti-Fuzzy) normal sub – pentant group of a group G that every fuzzy (Anti-Fuzzy) normal sub – pentant group of a group G is a fuzzy (Anti-Fuzzy) normal subgroup of the group G . Converse part is not true .

3.5. Main Theorem:
Every Fuzzy (Anti-Fuzzy) Normal Sub – N group of a group G is a Fuzzy (Anti-Fuzzy) Normal Subgroup of the group G but not conversely .

proof:
It follows from the definition of a fuzzy (Anti-Fuzzy) normal sub – N group of a group G that every fuzzy (Anti-Fuzzy) normal sub – N group of a group G is a fuzzy (Anti-Fuzzy) normal subgroup of the group G . Converse part is not true .

3.6. Main theorem :

The union of two fuzzy (Anti-Fuzzy) normal subgroups of a group G is a fuzzy (Anti-Fuzzy) normal subgroup if and only if one is contained in the other.

Proof:

Necessary part:

Let μ_1 and μ_2 be two fuzzy (Anti-Fuzzy) normal subgroups of G such that one is contained in the other .

To Prove:

$\mu_1 \cup \mu_2$ is a fuzzy (Anti-Fuzzy) normal subgroup of G.

Let $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$.

Since μ_1 and μ_2 are fuzzy (Anti-Fuzzy) normal subgroups of G, which implies if for all x, y $\in$ G,

$$\left.\begin{aligned} \mu_1 (xy) &= \mu_1(yx) \\ \mu_2 (xy) &= \mu_2(yx). \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots(1).$$

Let the union of two fuzzy subsets μ_1 , μ_2 is defined by

$$\mu_1 \cup \mu_2(xy) = \max \{\mu_1(xy), \mu_2 (xy)\} \quad \ldots\ldots\ldots \ldots\ldots\ldots (2).$$

By (1) and (2),

$$\mu_1 \cup \mu_2(xy) = \mu_1(xy) = \mu_1(yx) = \mu_1 \cup \mu_2(yx)$$

Similarly, $$\mu_1 \cup \mu_2(xy) = \mu_2(xy) = \mu_2(yx) = \mu_1 \cup \mu_2(yx) \quad \ldots\ldots\ldots(3).$$

From (3) ,

$$\rightarrow \quad \mu_1 \cup \mu_2(xy) = \mu_1 \cup \mu_2(yx) .$$

Hence $\mu_1 \cup \mu_2$ is a fuzzy (Anti-Fuzzy) normal subgroup of G.

Sufficient Part:

Suppose $\mu_1 \cup \mu_2$ is a fuzzy (Anti-Fuzzy) normal subgroup of G.

To Claim: $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$.

Since μ_1, and μ_2 are fuzzy (Anti-Fuzzy) normal subgroup of G is obviously a fuzzy (Anti-Fuzzy) subgroup of G and $\mu_1 \cup \mu_2$ is a fuzzy normal subgroup of G.

By using the following theorem:

The union of two fuzzy (Anti-Fuzzy) subgroups of a group G is a fuzzy (Anti-Fuzzy) subgroup if and only if one is contained in the other.

Which implies , $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$.

Hence, The union of two fuzzy (Anti-Fuzzy) normal subgroups of a group G is a fuzzy (Anti-Fuzzy) normal subgroup if and only if one is contained in the other.

Corollary:

In this, Main theorem replace "A" in the place of μ and "min" in the place of "max" for Anti-Fuzzy Normal respectively.

3.7. Main theorem :

The union of two fuzzy (Anti-Fuzzy) normal sub-bigroups of a group G is a fuzzy (Anti-Fuzzy) normal sub-bigroup if and only if one is contained in the other.

Proof:

Necessary part:

Let μ_1 and μ_2 be two fuzzy (Anti-Fuzzy) normal sub-bigroups of G such that one is contained in the other .

To Prove:

$\mu_1 \cup \mu_2$ is a fuzzy (Anti-Fuzzy) normal sub-bigroup of G.

Let $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$.

Since μ_1 and μ_2 are fuzzy (Anti-Fuzzy) normal sub-bigroups of G, which implies if for all x, y $\in$ G,

$$\left.\begin{array}{l}\mu_1(xy) = \mu_1(yx)\\ \mu_2(xy) = \mu_2(yx).\end{array}\right\} \quad \ldots\ldots\ldots\ldots(1)$$

Let the union of two fuzzy subsets μ_1 , μ_2 is defined by

$$\mu_1 \cup \mu_2(xy) = \max\{\mu_1(xy), \mu_2(xy)\} \quad \ldots\ldots\ldots\ldots (2)$$

By (1) and (2),

$$\mu_1 \cup \mu_2(xy) = \mu_1(xy) = \mu_1(yx) = \mu_1 \cup \mu_2(yx)$$

Similarly,

$$\left.\mu_1 \cup \mu_2(xy) = \mu_2(xy) = \mu_2(yx) = \mu_1 \cup \mu_2(yx)\right\} \quad \ldots\ldots(3)$$

From (3) ,

$$\rightarrow \quad \mu_1 \cup \mu_2(xy) = \mu_1 \cup \mu_2(yx) .$$

Hence $\mu_1 \cup \mu_2$ is a fuzzy (Anti-Fuzzy) normal sub-bigroup of G.

Sufficient Part:

Suppose $\mu_1 \cup \mu_2$ is a fuzzy (Anti-Fuzzy) normal sub-bigroup of G.

To Claim: $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$.

Since μ_1, and μ_2 are fuzzy (Anti-Fuzzy) normal sub-bigroup of G is obviously a fuzzy (Anti-Fuzzy) sub-bigroup of G and $\mu_1 \cup \mu_2$ is a fuzzy (Anti-Fuzzy) normal sub-bigroup of G is also a fuzzy (Anti-Fuzzy) sub-bigroup of G.

By using the following theorem:

The union of two fuzzy (Anti-Fuzzy) sub-bigroups of a group G is a fuzzy (Anti-Fuzzy) sub-bigroup if and only if one is contained in the other.

Which implies , $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$.

Hence, The union of two fuzzy (Anti-Fuzzy) normal sub-bigroups of a group G is a fuzzy (Anti-Fuzzy) normal sub-bigroup if and only if one is contained in the other.

Corollary:

In this, Main theorem replace "A" in the place of μ and "min" in the place of "max" for Anti-Fuzzy Normal respectively.

3.8. Main theorem :

The union of three fuzzy (Anti-Fuzzy) normal sub-trigroups of a group G is a fuzzy (Anti-Fuzzy) normal sub-trigroup if and only if one is contained in the other.

Proof:

Necessary part:

Let μ_1 , μ_2 and μ_3 are three fuzzy (Anti-Fuzzy) normal sub-trigroups of G such that one is contained in the other .

To Prove:

$\mu_1 \cup \mu_2 \cup \mu_3$ is a fuzzy (Anti-Fuzzy) normal sub-trigroup of G.

Let $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$.

Since μ_1 and μ_2 ,μ_3 are fuzzy (Anti-Fuzzy) normal sub-trigroups of G, which implies if for all x, y $\in$ G,

$$\left.\begin{array}{l}\mu_1(xy) = \mu_1(yx)\\ \mu_2(xy) = \mu_2(yx).\\ \mu_3(xy) = \mu_3(yx).\end{array}\right\} \quad \ldots\ldots\ldots\ldots(1)$$

Let the union of three fuzzy subsets μ_1 , μ_2, μ_3 is defined by

$$\mu_1 \cup \mu_2 \cup \mu_3(xy) = \max\{\mu_1(xy), \mu_2(xy), \mu_3(xy)\} \quad \ldots\ldots\ldots (2)$$

By (1) and (2),

$$\left.\begin{array}{l}\mu_1 \cup \mu_2 \cup \mu_3 (xy) = \mu_1(xy) = \mu_1(yx) = \mu_1 \cup \mu_2 \cup \mu_3 (yx) \\ \mu_1 \cup \mu_2 \cup \mu_3 (xy) = \mu_2(xy) = \mu_2(yx) = \mu_1 \cup \mu_2 \cup \mu_3 (yx) \\ \mu_1 \cup \mu_2 \cup \mu_3 (xy) = \mu_3(xy) = \mu_3(yx) = \mu_1 \cup \mu_2 \cup \mu_3 (yx)\end{array}\right\} \quad \text{........(3)}$$

Similarly,

From (3) ,

$\rightarrow \quad \mu_1 \cup \mu_2 \cup \mu_3 (xy) = \mu_1 \cup \mu_2 \cup \mu_3 (yx)$.

Hence $\mu_1 \cup \mu_2 \cup \mu_3$ is a fuzzy (Anti-Fuzzy) normal sub-trigroup of G.

Sufficient Part:

Suppose $\mu_1 \cup \mu_2 \cup \mu_3$ is a fuzzy (Anti-Fuzzy) normal sub-trigroup of G.

To Claim: $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$.

Since μ_1, and μ_2 , μ_3 are fuzzy (Anti-Fuzzy) normal sub-trigroup of G is obviously a fuzzy (Anti-Fuzzy) sub-trigroup of G and $\mu_1 \cup \mu_2 \cup \mu_3$ is also a fuzzy (Anti-Fuzzy) normal sub-trigroup of G is also a fuzzy (Anti-Fuzzy) sub-trigroup of G.

By using the following theorem:

The union of three fuzzy (Anti-Fuzzy) sub-trigroups of a group G is a fuzzy (Anti-Fuzzy) sub-trigroup if and only if one is contained in the other.

Which implies , $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$.

Hence, The union of three fuzzy (Anti-Fuzzy) normal sub-trigroups of a group G is a fuzzy (Anti-Fuzzy) normal sub-trigroup if and only if one is contained in the other.

Corollary:

In this, Main theorem replace "A" in the place of μ and "min" in the place of "max" for Anti-Fuzzy Normal respectively.

3.9. Main theorem :

The union of four fuzzy (Anti-Fuzzy) normal sub- Quadratic groups of a group G is a (Anti-Fuzzy) fuzzy normal sub- Quadratic group if and only if one is contained in the other.

Proof:

Necessary part:

Let μ_1 , μ_2 and μ_3 , μ_4 are four fuzzy (Anti-Fuzzy) normal sub- Quadratic groups of G such that one is contained in the other .

To Prove:

$\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4$ is a fuzzy (Anti-Fuzzy) normal sub- Quadratic group of G.

Let $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$.

$\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$.

Since μ_1 and μ_2 ,μ_3, μ_4 are fuzzy (Anti-Fuzzy) normal sub- Quadratic groups of G, which implies if for all x, y $\in$ G,

$$\left.\begin{array}{l}\mu_1 (xy) = \mu_1(yx) \\ \mu_2 (xy) = \mu_2(yx). \\ \mu_3 (xy) = \mu_3(yx). \\ \mu_4 (xy) = \mu_4(yx).\end{array}\right\} \quad \text{...(1)}$$

Let the union of four fuzzy subsets μ_1 , μ_2, μ_3,μ_4 is defined by

$$\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (xy) = \max \{\mu_1(xy), \mu_2 (xy), \mu_3 (xy), \mu_4 (xy)\} \quad \text{.......... ...... (2)}$$

By (1) and (2),

$$\left.\begin{array}{l} \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (xy) = \mu_1(xy) = \mu_1(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (yx) \\ \text{Similarly, } \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (xy) = \mu_2(xy) = \mu_2(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (yx) \\ \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (xy) = \mu_3(xy) = \mu_3(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (yx) \\ \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (xy) = \mu_4(xy) = \mu_4(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (yx) \end{array}\right\} \quad .....(3).$$

From (3) ,

$\rightarrow$ $\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (xy) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 (yx)$.

Hence $\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4$ is a fuzzy (Anti-Fuzzy) normal sub- Quadratic group of G.

Sufficient Part:

Suppose $\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4$ is a fuzzy (Anti-Fuzzy) normal sub- Quadratic group of G.

To Claim:

$\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$.

$\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$.

Since μ_1, and μ_2 , μ_3 ,μ_4 are fuzzy (Anti-Fuzzy) normal sub- Quadratic group of G is obviously a fuzzy (Anti-Fuzzy) sub- Quadratic group of G and $\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4$ is also a fuzzy (Anti-Fuzzy) normal sub- Quadratic group of G is also a fuzzy (Anti-Fuzzy) sub- Quadratic group of G.

By using the following theorem:

The union of four fuzzy (Anti-Fuzzy) sub- Quadratic groups of a group G is a fuzzy (Anti-Fuzzy) sub- Quadratic group if and only if one is contained in the other.

Which implies , $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$, $\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$.

Hence, The union of four fuzzy (Anti-Fuzzy) normal sub- Quadratic groups of a group G is a fuzzy (Anti-Fuzzy) normal sub- Quadratic group if and only if one is contained in the other.

Corollary:

In this, Main theorem replace "A" in the place of μ and "min" in the place of "max" for Anti-Fuzzy Normal respectively.

3.10. Main theorem :

The union of five fuzzy (Anti-Fuzzy) normal sub- pentant groups of a group G is a (Anti-Fuzzy) fuzzy normal sub- pentant group if and only if one is contained in the other.

Proof:

Necessary part:

Let μ_1 , μ_2 and μ_3 , μ_4 , μ_5 are five fuzzy (Anti-Fuzzy) normal sub- pentant groups of G such that one is contained in the other .

To Prove:

$\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5$ is a fuzzy (Anti-Fuzzy) normal sub- pentant group of G.

Let $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$

$\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$,

$\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$, $\mu_5 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_5$, $\mu_5 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_5$, $\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$

Since μ_1 and μ_2 ,μ_3, μ_4 , μ_5 are fuzzy (Anti-Fuzzy) normal sub- pentant groups of G, which implies if for all x, y $\in$ G,

$$\left.\begin{array}{l}\mu_1(xy)=\mu_1(yx)\\ \mu_2(xy)=\mu_2(yx)\\ \mu_3(xy)=\mu_3(yx)\\ \mu_4(xy)=\mu_4(yx).\\ \mu_5(xy)=\mu_5(yx).\end{array}\right\} \quad \ldots\ldots\ldots\ldots(1).$$

Let the union of four fuzzy subsets μ_1 , μ_2, μ_3,μ_4 , μ_5 is defined by

$\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5$ (xy) = max{μ_1(xy),μ_2(xy),μ_3(xy), μ_4(xy), μ_5(xy)} ………. …... (2)

By (1) and (2),

$$\left.\begin{array}{l}\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (xy) = \mu_1(xy) = \mu_1(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (yx)\\ \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (xy) = \mu_2(xy) = \mu_2(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (yx)\\ \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (xy) = \mu_3(xy) = \mu_3(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (yx)\\ \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (xy) = \mu_4(xy) = \mu_4(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (yx)\\ \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (xy) = \mu_5(xy) = \mu_5(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (yx)\end{array}\right\} \ldots\ldots\ldots\ldots (3)$$

From (3) ,

$\rightarrow \quad \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (xy) = \mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 (yx)$.

Hence $\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5$ is a fuzzy (Anti-Fuzzy) normal sub- pentant group of G.

Sufficient Part:

Suppose $\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5$ is a fuzzy (Anti-Fuzzy) normal sub- pentant group of G.

To Claim:

$\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$.

$\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$,

$\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$, $\mu_5 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_5$, $\mu_5 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_5$, $\mu_4 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_4$.

Since μ_1, and μ_2 , μ_3 ,μ_4 ,μ_5 are fuzzy (Anti-Fuzzy) normal sub- pentant group of G is obviously a fuzzy (Anti-Fuzzy) sub- pentant group of G and $\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5$ is also a fuzzy (Anti-Fuzzy) normal sub- pentant group of G is also a fuzzy (Anti-Fuzzy) sub- pentant group of G.

By using the following theorem:

The union of five fuzzy (Anti-Fuzzy) sub- pentant groups of a group G is a fuzzy (Anti-Fuzzy) sub- pentant group if and only if one is contained in the other.

Which implies , $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$, $\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$, $\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$, $\mu_5 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_5$, $\mu_5 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_5$, $\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$.

Hence, The union of five fuzzy (Anti-Fuzzy) normal sub- pentant groups of a group G is a fuzzy (Anti-Fuzzy) normal sub- pentant group if and only if one is contained in the other.

Corollary:

In this, Main theorem replace "A" in the place of μ and "min" in the place of "max" for Anti-Fuzzy Normal respectively.

Similarly for "n",

3.11. Main theorem :

The union of "n" fuzzy (Anti-Fuzzy) normal sub- "n" groups of a group G is a fuzzy (Anti-Fuzzy) normal sub- "n" group if and only if one is contained in the other.

Proof:

Necessary part:

Let μ_1 , μ_2 and μ_3 , μ_4 , μ_5…. μ_n are "n" fuzzy (Anti-Fuzzy) normal sub- "n" groups of G such that one is contained in the other .

To Prove:

$\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \cup \mu_5 \ldots\ldots \cup \mu_n$ is a fuzzy (Anti-Fuzzy) normal sub- "n" group of G.

Let $\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$,
$\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$,
$\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$, $\mu_5 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_5$, $\mu_5 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_5$, $\mu_4 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_4$,…
……………… $\mu_1 \subseteq \mu_n$ and $\mu_n \subseteq \mu_1$, $\mu_n \subseteq \mu_3$ and $\mu_3 \subseteq \mu_n$, $\mu_n \subseteq \mu_2$ and $\mu_2 \subseteq \mu_n$.

Since μ_1 and μ_2 ,μ_3, μ_4 , μ_5…….μ_n are fuzzy (Anti-Fuzzy) normal sub- "n" groups of G, Which implies, if for all x, y $\in$ G,

$$\left.\begin{aligned} \mu_1 (xy) &= \mu_1(yx) \\ \mu_2 (xy) &= \mu_2(yx). \\ \mu_3 (xy) &= \mu_3(yx). \\ \mu_4 (xy) &= \mu_4(yx). \\ &\ldots\ldots\ldots \\ &\ldots\ldots\ldots \\ \mu_n (xy) &= \mu_n(yx). \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots(1).$$

Let the union of "n" fuzzy subsets μ_1 , μ_2, μ_3,μ_4 , μ_5,…… , μ_n is defined by

$\mu_1 \cup \mu_2 \cup \mu_3 \cup \mu_4 \ldots\ldots \cup \mu_n (xy) = \max\{\mu_1(xy),\mu_2(xy),\mu_3(xy),\ldots, \mu_n(xy)\}$ ………. …... (2)

By (1) and (2),

$$\left.\begin{aligned} \mu_1 \cup \mu_2 \cup \mu_3 \ldots \cup \mu_n (xy) &= \mu_1(xy) = \mu_1(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots\ldots \cup \mu_n (yx) \\ \mu_1 \cup \mu_2 \cup \mu_3 \ldots \cup \mu_n (xy) &= \mu_2(xy) = \mu_2(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots\ldots \cup \mu_n (yx) \\ \mu_1 \cup \mu_2 \cup \mu_3 \ldots \cup \mu_n (xy) &= \mu_3(xy) = \mu_3(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots\ldots \cup \mu_n (yx) \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots \cup \mu_n (xy) &= \mu_n(xy) = \mu_n(yx) = \mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots \cup \mu_n (yx) \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots(3).$$

From (3),

$\rightarrow \quad \mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots \cup \mu_n (xy) = \mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots \cup \mu_n (yx)$.

Hence $\mu_1 \cup \mu_2 \cup \ldots\ldots \cup \mu_n$ is a fuzzy (Anti-Fuzzy) normal sub- "n" group of G.

Sufficient Part:

Suppose $\mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots \cup \mu_n$ is a fuzzy (Anti-Fuzzy) normal sub- "n" group of G.

To Claim:

$\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$
$\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$,
$\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$, $\mu_5 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_5$, $\mu_5 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_5$, $\mu_4 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_4$,…
……………… $\mu_1 \subseteq \mu_n$ and $\mu_n \subseteq \mu_1$, $\mu_n \subseteq \mu_3$ and $\mu_3 \subseteq \mu_n$, $\mu_n \subseteq \mu_2$ and $\mu_2 \subseteq \mu_n$.

Since μ_1, and μ_2 , μ_3 ,μ_4 ,μ_5 are fuzzy (Anti-Fuzzy) normal sub- "n" group of G is obviously a fuzzy (Anti-Fuzzy) sub- "n" group of G and $\mu_1 \cup \mu_2 \cup \mu_3 \ldots\ldots \cup \mu_n$ is also a fuzzy (Anti-Fuzzy) normal sub-"n" group of G is also a fuzzy (Anti-Fuzzy) sub-"n" group of G.

By using the following theorem:
The union of four fuzzy (Anti-Fuzzy) sub- "n" groups of a group G is a fuzzy (Anti-Fuzzy) sub- "n" group if and only if one is contained in the other.

Which implies,

$\mu_1 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_1$, $\mu_1 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_1$, $\mu_3 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_3$
$\mu_1 \subseteq \mu_4$ and $\mu_4 \subseteq \mu_1$, $\mu_4 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_4$, $\mu_4 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_4$,
$\mu_1 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_1$, $\mu_5 \subseteq \mu_3$ and $\mu_3 \subseteq \mu_5$, $\mu_5 \subseteq \mu_2$ and $\mu_2 \subseteq \mu_5$, $\mu_4 \subseteq \mu_5$ and $\mu_5 \subseteq \mu_4$,…
……………… $\mu_1 \subseteq \mu_n$ and $\mu_n \subseteq \mu_1$, $\mu_n \subseteq \mu_3$ and $\mu_3 \subseteq \mu_n$, $\mu_n \subseteq \mu_2$ and $\mu_2 \subseteq \mu_n$.

Hence, The union of four fuzzy (Anti-Fuzzy) normal sub- "n" groups of a group G is a fuzzy (Anti-Fuzzy) normal sub- "n" group if and only if one is contained in the other.

Corollary:
In this, Main theorem replace "A" in the place of μ and "min" in the place of "max" for Anti-Fuzzy Normal respectively.

IV. CONCLUSION

In this paper, I have derived the definition of Fuzzy normal subgroup, definition of Fuzzy normal sub bigroup, definition of Fuzzy normal sub trigroup, definition of Fuzzy normal sub – Quadratic group, definition of fuzzy normal sub- Pentant group and definition of Fuzzy normal sub–N groups . Theorems of union of fuzzy normal based on these definitions have been derived and the union of anti- fuzzy normal based on these definitions are also have been derived as replace "A" in the place of μ and "min" in the place of "max" for Anti-Fuzzy Normal in Main theorems respectively.

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