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On Intuitionistic Fuzzy bi- Ideal With respect To an Element of a near Ring

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Abstract

In this paper we introduce the notions of bi-ideal with respect to an element r denoted by (r-bi- ideal) of a near ring , and the notion fuzzy bi- ideal with respect to an element of a near ring and the relation between F-r-bi-ideal and r-bi-ideal of the near ring, we studied the image and inverse image of r-bi- ideal under epimomorphism ,the intersection of r-bi- ideals and the relation between this ideal and the quasi ideal of a near ring, also we studied the notion intuitionistic fuzzy bi-ideal with respect to an element r of the near ring N, and give some theorem about this ideal .

Keywords: Near ring, ideal of a near ring ,bi- ideal, quasi- ideal , P-regular of near ring , intuitionistic fuzzy, intuitionistic fuzzy bi-ideal .

الحدس الضبابي للمثالية bi بالنسبة لعنصر ما في الحلقة القريبة

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الخلاصة

قدمنا في هذا البحث بعض المفاهيم ومنها المثالية bi–ideal بالنسبة لعنصر ما في الحلقة القريبة N والتي يرمز لها بالرمز (r–bi–ideal)، كما ودرسنا الصور المباشرة ومعكوس الصورة للمثالية تحت التشاكل الشامل كما وأعطينا بعض الخواص التي تتعلق بهذه المثالية وعلاقتها ببعض المثاليات المعروفة وأيضا تطرقنا إلى مفهوم جديد وهو المثالية الضبابية bi–ideal بالنسبة لعنصر ما في الحلقة القريبة N وتم إعطاء يعض المبرهنات والنتائج الخاصة بها .وكما قدمنا مفهوم intuitionistic fuzzy bi– ideal بالنسبة لعنصر ما في الحلقة القريبة مع إعطاء بعض المبرهنات والامثلة عليها .

Introduction

The notion of near ring is first define by G. Pliz [1] in 1983 , the notion of bi- ideal interfused by N.Ganesan [2] ,in 1986 the notion intutionistis fuzzy sets denoted by K.T. Atanassov [3], in 1987 T.T. Chelvam , N. Ganesan denoted the notion bi-ideals of near-rings, in 1997 the notion Fuzzy Ideal denoted by D.T.K ,and Biswas[4] , in 2012 the notion P-regular near ring denoted by Aphisit in [5].

1.Preliminaries

In this section we give some concepts that we need.

Definition (1.1) [1]

A left near ring is a set N together with two binary operations “+” and ”.” such that

(1) (N,+) is a group (not necessarily abelian)

(2) (N, .) is a semigroup.

(3) $(n_1 + n_2) . n_3 = n_1 . n_3 + n_2 . n_3$

For all $n_1, n_2, n_3, \in N$,

Definition (1.2) [6]:

Let N be a near ring. A normal subgroup I of (N,+) is called a left ideal of N if

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(1) $I.N \subseteq I$.

(2). $\forall\, n, n_1 \in N$ and for all $i \in I$, $(n_1 + i) \cdot n - n_1 \in I$

Definition (1.3) [7]

Let (N_1,+,.) and (N_2 ,+′,.′) be two near rings. The mapping f : $N_1 \to N_2$ is called a near ring homomorphism if for all m, n $\in N_1$

f(m+ n) = f(m) +′ f(n) , f(m. n) = f(m) .′ f(n).

Theorem (1.4) [5]

Let $f : (N_1,+,.) \to (N_2,+',.')$ be a near ring homomorphism

(1) If I is an ideal of a near ring N_1 , then f(I) is an ideal of a near ring N_2.

(2) If J is an ideal of a near ring N_2 , then $f^{-1}(J)$ is an ideal of the near ring N_1

Definition (1.5) [8]

A nonempty subset Q of a near ring N is called a quasi ideal of N if

(1) Q together with addition is a subgroup of N .

(2) $QN \cap NQ \subseteq Q$.

Definition (1.6) [2]

A nonempty subset B of a near ring N is called a bi-ideal of N if

(1) B together with addition is a subgroup of N.

(2) $BNB \subseteq B$.

Definition (1.7) [9]

Let N be a near ring with unity and P an ideal of N .Then N is said to be P-regular near ring if for each $x \in N$ there exists $y \in N$ such that $xyx - x \in P$.

Definition (1.8) [10]

A near ring N is called a distributive near ring if $a(b+c) = ab + ac$ for all $a,b,c \in N$.

Theorem(1.9)[11]

Let N be a P-regular near ring .Then for each $n \in N$ there exists $n' \in N$ such that $n'n \in P$.

Theorem(1.10) [11]

Let N be a P-regular distributive near ring .Then for every left ideal L and right ideal R of N .

$(P+R) \cap (P+L) = P + RL$.

Definition (1.11)[2]

Let N be a non- empty set a mapping $\mu : N \to [0,1]$ is called a fuzzy subset of N, where [0,1] is a closed interval of real numbers.

Definition (1.12) [4]

Let μ be a non- empty fuzzy subset of a near ring N ,that is $\mu(y) \neq 0$ for some $y \in N$) then μ is said to be fuzzy ideal of N if it satisfies the following conditions :

(1) $\mu(z - y) \geq \min\{\mu(z), \mu(y)\}$;

(2) $\mu(z.y) \geq \min\{\mu(z), \mu(y)\}$;

(3) $\mu(y + z - y) \geq \mu(z)$;

(4) $\mu(z.y) \geq \mu(y)$, $\forall$ y,z$\in$N.

When the subset of N satisfies 1 , 2 is called fuzzy sub near ring.

Definition (1.13) [3]

An intuitionistic fuzzy set A in a non-empty set X is an object having the form

A= $\{(x, \mu_A(x), \lambda_A(x)) | x \in X\}$, where the functions $\mu_A : X \to [0,1]$ and $\lambda_A : X \to [0,1]$ denoted the degree of membership and the degree of non – membership of each element $x \in X$ to the set A , respectively ,and $0 \leq \mu_A(x) + \lambda_A(x) \leq 1$ for all $x \in X$.

Definition (1.14)[3]

An intuitionistic fuzzy set $A=(\mu_A,\lambda_A)$ in N is an intuitionistic fuzzy subnear ring of N if for $x, y \in N$

(1) $\mu_A(x-y) \geq \min\{\mu_A(x), \mu_A(y)\}$

(2) $\mu_A(xyz) \geq \min\{\mu_A(x), \mu_A(z)\}$

(3) $\lambda_A(x-y) \leq \max\{\lambda_A(x), \lambda_A(y)\}$

(4) $\lambda_A(xyz) \leq \max\{\lambda_A(x), \lambda_A(z)\}$

Proposition (1.15) [1]

Let X be a non- empty set . A mapping $\mu : N \to [0,1]$ is a fuzzy set in X , the complement of μ ,denoted by μ^c , is the fuzzy set in X given by $\mu^c(x)=1-\mu(x)$ for all $x \in N$ for any $I \subseteq X, X_I$ denote the characteristic function of I .

For any fuzzy set μ and $h \in [0,1]$, we define two sets , $\bigcup(\mu_A, h)=\{x \in X | \mu(x) \geq h\}$ and $L(\mu_A, h)=\{x \in X | \mu(x) \leq h\}$ Which are called upper and lower h-level cut of μ respectively, and can be used to the characterization of μ .

2- bi-ideal with respect to an element of a near ring N

In this section we devoted to study bi-ideal with respect to an element r of a near ring N and give some properties, theorem about this ideal .

Definition (2.1)

A nonempty subset B of a near ring N is called a bi-ideal with respect to an element of N and denoted by r-b-ideal of a near ring if

(1) B together with addition is a subgroup of N.

(2) $r.BNB \subseteq r.B$, $r \in N$.

Example (2.2).

Let N= {0,a,b,c} be the near ring defined by caleys

+	0	A	b	c
0	0	A	b	c
a	A	0	c	b
b	B	C	0	a
c	C	B	a	0

.	0	a	b	c
0	0	0	0	0
A	0	b	0	b
B	0	0	0	0
C	0	b	0	b

Then B={0,a} is b-bi-ideal since $b.BNB \subseteq b.B$

Remark (2.3)

If B_1 and B_2 be two r-bi-ideal of near ring N, then B_1. B_2 of N may be not r-bi-ideal

Example (2.4)

Considers the near ring N={ 0,a,b,c} with addition and multiplication defined by the following tables.

+	0	1	2	3
0	0	1	2	3
1	1	0	3	2
2	2	3	0	1
3	3	2	1	0

.	0	1	2	3
0	0	0	0	0
1	0	2	0	2
2	0	0	0	0
3	0	2	0	2

Let B_1 ={0,3}and B_2={1,2,3} are two 3-bi-ideal of N but $B_1 \cap B_2=\{3\}$ is not two 3-bi-ideal of N.

Remark (2.5)

Not all r-bi-ideal of a near ring are bi-ideal of N.

Example (2.6)

Consider the near ring N in example (2.2) let B={0,b} be b-bi-ideal but B is not bi-ideal of N since $BNB \not\subset B$

Theorem (2.7)

Let (N_1,+,.) and (N_2,+′,.′) be two near rings , $f: N_1 \to N_2$ be an epimomorphism and B be r-bi- ideal of N_1 .Then f(B) is f(r)- bi-ideal of N_2 .

Proof

Let B be r-bi- ideal of N_1 , f(B) is a subgroup of N_2 to prove f(B) is an r-bi-ideal of N_2

Let $r \in N_1$, such that $f(r) \in N_2$,hence

$r.BNB \subseteq rB$ Since B is r- bi- ideal of N_1

$f(r.BN_1B) \subseteq f(r.B)$ f be an epimomorphism

$f(r).'f(B).'f(N_1).'f(B) \subseteq f(r).'f(B).$

$f(r).'f(B).'N_2.'f(B) \subseteq f(r).'f(B).$

f(B) is f(r)- bi- ideal of N_2

Theorem (2.8)

Let (N_1, +,.) and (N_2,+′,.′) be two near rings, and $f: N_1 \to N_2$ be epiomomorphism and J be a f(r)- bi-ideal of N_2 . Then $f^{-1}(J)$ is a r-bi- ideal of N_1 , where y= f(r) , $\ker f \subseteq f^{-1}(J)$.

Proof

Let $r \in N_1$, $f^{-1}(J)$ is a subgroup of N_1

$y\ .'JN_2J \subseteq y\ .'J$

$f^{-1}(y\ .'JN_2J) \subseteq f^{-1}(y\ .'J)$

$f^{-1}(y).f^{-1}(J)f^{-1}(N_2)f^{-1}(J) \subseteq f^{-1}(y).f^{-1}(J)$

$r.f^{-1}(J)N_1f^{-1}(J) \subseteq r.f^{-1}(J)$

$\to$ $f^{-1}(J)$ is a r-bi-ideal of N_1.

Remark (2.9)

Not all r-bi-ideals of the near ring N are quasi ideal.

Example (2.10).

Let N= {0,a,b,c} be the near ring defined by caleys

+	0	A	b	c
0	0	A	b	c
a	A	0	c	b
b	B	C	0	a
c	C	B	a	0

.	0	a	b	c
0	0	0	0	0
a	0	b	0	b
b	0	0	0	0
c	0	b	0	b

Let B= {0, a} is c-bi-ideal since $c.BNB \subseteq c.B$ but is not quasi ideal

Theorem (2.11)

Let N be a P-regular near ring and B a r-bi-ideal of N. Then every $y \in B$ There exist $p' \in P$ and $b' \in B$ such that $y = p' + b'$.

Proof

Let N be a P-regular near ring and B a r-bi-ideal of N and $y \in B \subset N$, there exists $z \in N$ such that $r(yzy) - y = p$ for some $p \in P$ thus $y = -p + r(yzy)$ since B is r-bi- ideal of N ,we have $r(yzy) \in rBNB \subseteq rB$ since $p \in P$ together with addition is a subgroup of N , we have $-p \in P$ put $p' = -p$ and $b' = r(yzy)$ thus $y = -p + r(yzy) = p' + b' \in P + B.$

Theorem (2.12)

Let N be a P-regular distributive near ring and let B_1, B_2 are a r-bi-ideals of N. if $b \in B_1 \cap B_2$ and $y \in N$, then the element b can be represented as $b = p + rb_1y_1b_2$ and $b_1y_1b_2yP \subseteq P$ for some $p \in P$, $r, y_i \in N, b_1 \in B_1$ and $b_2 \in B_2$.

Proof

Let $b \in B_1 \cap B_2$ since N is a P-regular near ring there exists $y_1 \in N$ such that $rby_1b - b \in P$ since $b \in B_1 \cap B_2$ by theorem (1.9) we have $b = p_1 + b_1$ for some $p_1 \in P$ and $b_1 \in B$, $b = p_2 + b_2$ for some $p_2 \in P$ and $b_2 \in B$,since $rby_1b - b \in P$,we have $rby_1b - b = p_3$ for some $p_3 \in P$ .Thus $b = -p_3 + rby_1b$ .Hence

$= -p_3 + r(p_1 + b_1)y_1(p_2 + b_2)$

$= -p_3 + rp_1y_1p_2 + rp_1y_1b_2 + rb_1y_1p_2 + rb_1y_1b_2$ since P is an ideal of N ,t

$-p_3, rp_1y_1p_2, rp_1y_1b_2, rb_1y_1p_2, rb_1y_1b_2 \in P$

Then

$-p_3 + xp_1y_1p_2 + xp_1y_1b_2 + xb_1y_1p_2 = p_4$

For some $p_4 \in P$. Thus $b = p_4 + rb_1y_1b_2$

So $rb_1y_1b_2 = b - p_4$ hence

$rb_1y_1b_2yP = (b - p_4)yP \subseteq byP - p_4yP$

$\subseteq P + P \subseteq P.$

3-Intuitionistic fuzzy bi- ideal with respect to an element of a near ring

In this section we devoted to study fuzzy bi-ideal with respect to an element of a near ring N, we introduce the notion intuitionist fuzzy bi-ideal with respect to an element of the near ring N, and give some properties , theorem about this ideals.

Definition (3.1)

A fuzzy set μ of a near ring is called fuzzy bi- ideal with respect to an element of a near ring N if

(1) $\mu(r(x - y)) \geq \min\{\mu(rx), \mu(ry)\}$

$\forall x, y \in N, r \in N.$

(2) $\mu(r(xyz)) \geq \min\{\mu(rx), \mu(rz)\}$

$\forall x, y, z \in N, r \in N.$

It denoted by F-r-bi-ideal of N .

Example (3.2)

Consider the near ring N= {0,1,2,3}

With addition and multiplication defined by the following tables.

+	0	1	2	3
0	0	1	2	3
1	1	0	3	2
2	2	3	0	1
3	3	2	1	0

.	0	1	2	3
0	0	0	0	0
1	0	1	2	3
2	0	0	0	0
3	0	1	2	3

The fuzzy subset μ of N which is defined by

$$\mu(y) = \begin{cases} 0.9 & \text{if } y = 0,1 \\ 0 & \text{otherwise} \end{cases}$$

μ is F-2-bi-ideal of N

Definition (3.3)

An intuitionistic fuzzy set $A = (\mu_A, \lambda_A)$ in N is an intuitionistic fuzzy bi-ideal with respect to an element r of N if for all $x, y, z \in N, r \in N,$

(1) $\mu_A(\mathrm{r(x - y)}) \geq \min\{\mu_A(\mathrm{rx}), \mu_A(\mathrm{ry})\}$

(2) $\mu_A(\mathrm{r(xyz)}) \geq \min\{\mu_A(\mathrm{rx}), \mu_A(\mathrm{rz})\}$

(3) $\lambda_A(\mathrm{r(x - y)}) \leq \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{ry})\}$

(4) $\lambda_A(\mathrm{r(xyz)}) \leq \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{rz})\}$

Theorem (3.4)

An intuitionistic fuzzy set $A = (\mu_A, \lambda_A)$ in N is an intuitionistic F-r- bi-ideal of N if and only if the fuzzy set μ_A and λ_A^c are F-r- bi-ideal of N.

Proof

If $A = (\mu_A, \lambda_A)$ is an intuitionistic F-r-bi-ideal of N .then clearly μ_A is a F-r-bi-ideal of N, for all $x, y \in N$,

$$\lambda_A^c(\mathrm{r(x - y)}) = 1 - \lambda_A(\mathrm{r(x - y)})$$
$$\geq 1 - \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{ry})\}$$
$$= \min\{1 - \lambda_A(\mathrm{rx}), 1 - \lambda_A(\mathrm{ry})\}$$
$$= \min\{\lambda_A^c(\mathrm{rx}), \lambda_A^c(\mathrm{ry})\} \quad ,\forall\ \mathrm{x, y} \in \mathrm{N}, \mathrm{r} \in \mathrm{N},$$

$$\lambda_A^c(\mathrm{r(xyz)}) = 1 - \lambda_A(\mathrm{r(xyz)})$$
$$\geq 1 - \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{rz})\}$$
$$= \min\{1 - \lambda_A(\mathrm{rx}), 1 - \lambda_A(\mathrm{rz})\}$$
$$= \min\{\lambda_A^c(\mathrm{rx}), \lambda_A^c(\mathrm{rz})\}$$

thus λ_A^c is a F-r- bi-ideal of N. conversely that μ_A and λ_A^c are F-r- bi-ideal of N , then clearly the conditions 1,2 of definition (3.3) are valid .Now for all $x, y \in N, r \in N$.

$$1 - \lambda_A(\mathrm{r(x - y)}) = \lambda_A^c(\mathrm{r(x - y)})$$
$$= \min\{\lambda_A^c(\mathrm{rx}), \lambda_A^c(\mathrm{ry})\}$$
$$= 1 - \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{ry})\}$$

ther fore $\lambda_A(\mathrm{r(x - y)}) \leq \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{ry})\} \quad \forall\ \mathrm{x, y, z} \in \mathrm{N}, \mathrm{r} \in \mathrm{N},$

$$1 - \lambda_A(\mathrm{r(xyz)}) = \lambda_A^c(\mathrm{r(xyz)})$$
$$\geq \min\{\lambda_A^c(\mathrm{rx}), \lambda_A^c(\mathrm{rz})\}$$
$$= 1 - \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{rz})\}$$

therfore $\lambda_A(\mathrm{r(xyz)}) \leq \max\{\lambda_A(\mathrm{rx}), \lambda_A(\mathrm{rz})\}$

Thus $A = (\mu_A, \lambda_A)$ is an intuitionistic F-r- bi-ideal of N.

Theorem (3.5)

An intuitionistic fuzzy set $A = (\mu_A, \lambda_A)$ in N, is an intuitionistic F-r- bi-ideal of N if and only if $A = (\mu_A, \mu_A^c)$ and $A = (\lambda_A^c, \lambda_A)$ are intuitionistic F-r- bi-ideal of N.

Proof

If $A = (\mu_A, \lambda_A)$ is an intuitionistic F-r- bi-ideal of N, then $\mu_A = (\mu_A^c)^c$ and λ_A^c are F-r-bi-ideal of N, from theorem (3.4).Therefore $A = (\mu_A, \mu_A^c)$ and $A = (\lambda_A^c, \lambda_A)$ are intuitionistic F-r- bi-ideal of N.

Conversely if $A=(\mu_A,\mu_A^c)$, $A=(\lambda_A^c,\lambda_A)$ are intuitionistic F-r- bi-ideal of N, then the fuzzy sets μ_A and λ_A^c are F-r-bi-ideal of N ,therefore $A=(\mu_A,\lambda_A)$ is intuitionistic F-r- bi-ideal of N.

Proposition (3.6)

An intuitionistic fuzzy set $A=(\mu_A,\lambda_A)$ in N is a F-r-bi-ideal of N if and only if all non –empty set $\bigcup(\mu_A,h)$ and $\bigcup(\lambda_A,t)$ are r-bi-ideal of N for all of N $h\in \mathrm{Im}(\mu_A)$ and $t\in \mathrm{Im}(\lambda_A)$ respectively .

Proof

Suppose that $A=(\mu_A,\lambda_A)$ is an intuitionistic F-r-bi-ideal of N, for $x,y\in\bigcup(\mu_A,h)$,we have

$\mu_A(\mathrm{r(x-y)})\geq \min\{\mu_A(\mathrm{rx}),\mu_A(\mathrm{ry})\}\geq \mathrm{h}$

Therefore $r(x-y)\in\bigcup(\mu_A,h)$ let $x,z\in\bigcup(\mu_A,h)$ and $y\in N.$ then

$\mu_A(\mathrm{r(xyz)})\geq \min\{\mu_A(\mathrm{rx}),\mu_A(\mathrm{rz})\}\geq \mathrm{h}$ and so $\mathrm{r(xyz)}\in\bigcup(\mu_A,\mathrm{h})$ hence $\bigcup(\mu_A,h)$ is a r- bi-ideal of N .

For all $h\in \mathrm{Im}(\mu_A)$ .similarly we can show that $\bigcup(\lambda_A,t)$ is also a r- bi-ideal of N for all $t\in \mathrm{Im}(\lambda_A)$ .Conversely suppose that $\bigcup(\mu_A,h)$ and $\bigcup(\lambda_A,t)$ are r- bi-ideal of N for all $h\in \mathrm{Im}(\mu_A)$ and $t\in \mathrm{Im}(\lambda_A)$ respectively .Suppose that $x,y\in N$ and

$\mu_A(\mathrm{r(x-y)})\leq\min\{\mu_A(\mathrm{rx}),\mu_A(\mathrm{ry})\}$

Choose h such that $\mu_A(\mathrm{r(x-y)})\prec \mathrm{h}\prec \min\{\mu_A(\mathrm{rx}),\mu_A(\mathrm{ry})\}$ Then we get $x,y\in\bigcup(\mu_A,h)$ but

$r(x-y)\notin\bigcup(\mu_A,h)$ a contradiction. Hence $\mu_A(\mathrm{r(x-y)})\geq \min\{\mu_A(\mathrm{rx}),\mu_A(\mathrm{ry})\}.$

A similar argument shows that $\mu_A(\mathrm{r(xyz)})\geq \min\{\mu_A(\mathrm{rx}),\mu_A(\mathrm{rz})\}$

For all $x,y,z\in N.$ likewise we can show that

$\lambda_A(\mathrm{r(x-y)})\leq \max\{\lambda_A(\mathrm{rx}),\lambda_A(\mathrm{ry})\}$

$\lambda_A(\mathrm{r(xyz)})\leq \max\{\lambda_A(\mathrm{rx}),\lambda_A(\mathrm{rz})\}$

Hence $A=(\mu_A,\lambda_A)$ is an intuitionistic F-r- bi-ideal of N.

Theorem (3.7)

A non empty set B of N is r- bi-ideal of N if and only if $A=(\chi_B,\chi_B^c)$ is an intuitionistic F-r- bi-ideal of N.

Proof

Straight forward.

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