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On 3-semiprime Ideal With Respect To An element Of A near ring

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Abstract

In this paper ,we introduce the notions 3-semiprime ideal with respect to an element x denoted by (x-3-S-P-I) of a near ring and the 3-semiprime ideal near ring with respect to an element x denoted by (x-3-S-P-I near ring),and we studied the image and inverse image of x-3-S-P-I under epimomorphism and the direct product of x-3-S-P-I of near ring and we extension to fuzzify this notions and give some properties and examples about this .

الخلاصة

قدمنا في هذا البحث مفهومي المثالية 3-semiprime ideal بالنسبة لعنصر ما في الحلقة القريبة N والتي يرمـــز لها بالرمز (x-3-S-P-I)، وأيضا حـــلقـــة المثاليات القريبة 3-semiprime ideal بالنسبة لعنصر ما في N والتي يرمز لها بالرمز (x-3-S-P-I near ring). كما ودرسنا الصـور المباشـــرة ومعكـــوس الصـورة للمثاليـــة تحت التشاكل الشامل وأعطينا بعض الخواص التي تتعلق بهذه المثالية .بالإضافة إلى دراسة الحالة الضبابية لهذه المثالية مع بعض الخصائص والأمثلة حول الموضوع .

Mathematics Subject Classification : 08A72

Introduction

We will refer that all near rings and ideal in this paper are left .In 1905 ,L.E Dickson began the study of a near ring and later in 1930,Wieland has investigated it .Furth material about a near ring can be found [1].In 1965,L.A.Zadeh introduced the concept of fuzzy subset [7] .In 1982 W.Liu introduced the notion of a fuzzy ideal of near ring [13].In 1989 the notion of completely semi prime ideal(C.S.P.I) was introduced by P.DHeena[5].In 1991 N.J .Groenewald introduced the notion 3-semiprime of ideal near ring N [2] and in this year he introduced the notion 3-prime ideal of a near ring . The purpose of this paper is as mention in the abstract .

Key word

Near ring,3-prime ideal, completely prime ideal , union and intersection ideals,3-semi prime ideal.

1.Preliminaries

In this section we give some basic concepts that we need in second section .

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) [1]:

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

(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) [2]:

An ideal I of near ring N is called a 3-prime ideal for all a,b$\in$ N , $a.N.b \subseteq I$ implies $a \in I \vee b \in I$.

Definition (1.4) [3]

Let $(N_2 ,+',.')$ and $(N_1,+,.)$ 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

$f(m+ n) = f(m) +' f(n)$ and $f(m. n) = f(m) .' f(n)$.

Theorem (1.5) [4]

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

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

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

Theorem (1.6)[2]

Let $\{I_j\}$be a family of ideals of a near ring N ,then

(1) $\bigcap_{j\in J} I_j$ is an ideal of N.

(2) if $\{I_j\}$ is a chain, then $\bigcup_{j\in J} I_j$ is an ideal of N.

Definition (1.7) [5]

Let $\{Nj\}_{j\in J}$ be a family of near rings , J is an index set and

$\prod_{j\in J} N_j = \{(x_j) : x_j, for \quad all\, j \in J\}$ be the directed product of N_j with the component wise defined operations "+" and "." is called the direct product near ring of the near rings N_j .

Definition (1. 8) [5]

A near ring N is called integral domain if has no zero divisions.

Definition (1. 9) [6]

The factor near ring N/I is defined as in case of ring .

Definition (1.10) [7]

Let X be a non- empty set .A function $\mu : X \to [0,1]$ is called a fuzzy subset of X (a fuzzy set in X), where [0,1] is a closed interval of numbers .

Definition (1.11)[7]

Let μ be a fuzzy subset of a non empty set X .If $\mu(y) = 0$,for every $y \in X$ then μ is called empty fuzzy set .

Definition (1.12)[7]

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

Remark (1.13) [8]

If μ is a fuzzy ideal of near ring N then

(1) $\mu(z + y) = \mu(y + z)$

(2) $\mu(0) \geq \mu(z)$,$\forall$ y,z$\in$N.

Definition (1.14) [9]

Let $f : (N_1,+,.) \rightarrow (N_2,+',.')$ be a function. For a fuzzy set μ in N_2, we define

$(f^{-1}(\mu))(x) = \mu(f(x)$ for every $x \in N_1$. For a fuzzy set λ in X, $f(\lambda)$ is defined

by

$$(f(\lambda))(y) = \begin{cases} \sup \lambda(x) & \text{if } f(x)= y, y \in N_1 \\ 0 & \text{otherwise } y \end{cases}$$

Definition (1.15) [8]

Let μ be fuzzy ideal of a near ring N and f be a function from the near ring N_1 into a near ring N_2 . Then we call μ is f-invariant if and only if for all $y, z \in N, f(z) = f(y)$ implies $\mu(z) = \mu(y)$.

Definition (1.16) [10]

Let μ be a fuzzy ideal of a near ring N then μ^* is a fuzzy subset in N defined by $\mu^*(y) = \mu(y) + 1 - \mu(0), \forall y \in N$.

Definition (1.17) [9]

Let μ be a fuzzy subset of a near ring N and

$t \in [0,1]$ defined $\mu_t = \{n \in N : \mu(n) \geq t\} is$ called t-cut .

Definition (1.18) [11]

The fuzzy subset n_t of a near ring defined by $\begin{cases} t & y = n \\ 0 & y \neq n \quad \forall y \in N \end{cases}$ is called a fuzzy singleton , where $t \in [0,1]$.

Definition (1.19) [12]

let μ be a fuzzy ideal of N . then the set μ_* is defined by

$\mu_* = \{y \in N : \mu(y) = \mu(0)\}$ where 0 is the zero element of N .

Remark [1.20] [13]

let μ is a fuzzy ideal of N if and only if μ_* is an ideal of N .

2. 3-semiprime ideal with respect to an element

This section is devoted to study 3-semiprime ideal with respect to an element of a near ring ,and x-3-S-P-I near ring .

Definition (2.1)

An ideal I of near ring N is called 3-semiprime ideal with respect to an element of near ring denoted by (x-3-S-P-I) if for all $a \in N$ $x.(a.N.a) \subseteq I \rightarrow x.a \in I$.

Example(2.2)

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

+	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	a	0	a
a	0	a	a	0
b	0	a	b	c
c	0	a	c	b

Let I={0,a} is c-3-semiprime ideal since $c.(a.N.a) \subseteq I \rightarrow c.a \in I$.

Proposition (2.3)

Let $\{I_j\}_{j\in J}$ be a family of x- 3-semiprime ideal of a near ring N for all $j \in J$, $x \in N$ Then $\bigcap_{j\in J} I_j$ is a x- 3-semiprime ideal of N .

Proof

Let $x, a \in N$ $\bigcap_{j\in J} I_j$ is an ideal [1.7] since I_j is x- 3-semiprime ideal of N,

$I_j \neq \phi, I_j \subseteq N$, .let $x(a.N.a) \subseteq I$

$x(a.N.a) \subseteq I$, $x(a.N.a) \subseteq \bigcap_{j\in J} I_j$ since I_j is x- 3-semiprime ideal $x.a \subseteq I$

$x.a \subseteq \bigcap_{j\in J} I_j$ implies $\bigcap_{j\in J} I_j$ is an x- 3-semiprime ideal of N.

Proposition (2.4)

Let $\{I_j\}_{j\in J}$ be chain of a x-3-S-P-I of a near ring N ,then $\bigcup_{j\notin J} I_j$ is x-3-S-P-I of N where $j \in J$.

Proof

Let $\{I_j\}_{j\in J}$ Be chain of x-3-S-P-I of near ring . $\bigcup_{j\notin J} I_j$ is an ideal of N [1.7] Now let $x.(a.N.a)\subseteq \bigcup_{j\in J} I_j$, $x.(a.N.a)\subseteq I_j\ \forall j\in J$ since I_j is x-3-S-P-I $x.a\subseteq I_j \rightarrow x.a\subseteq \bigcup_{j\in J} I_j$ $\rightarrow \bigcup_{j\in J} I_j$ is an x- 3-semiprime ideal of N.

Definition (2.5)

The near ring N is called 3-semiprime ideal near ring with respect to an element x denoted by (x-3-S-P-I near ring), if every ideal of a near ring N is an x- 3-semiprime ideal of N ,where $x\in N$.

Example (2.6)

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

+	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	a	b	c
b	0	a	b	c
c	0	a	b	c

N is c-3-semi prime ideal near ring since all ideals of N ,$I_1\{0\}$ and I_2=N are c-3-semi prime ideal .

Proposition (2.7)

Let N be a near ring with multiplicative identity e' then I is e'- 3-S-P-I of near ring N if and only if I is a 3-semiprime ideal N.

Proof

$\leftarrow$

Let $y\in N, e'$ is the identity $e'(y.N.y)\subseteq I$ implies that $y.N.y\subseteq I$ since I is 3-S-P-I of N hence $y\in I$ implies $e'.y\in I$ there for I is e'- 3-S-P-I of N.

$\rightarrow$

Let $y\in N$ and I is e'-3-S-P-I of N let $y.N.y\subseteq I$, $e'(y.N.y)\subseteq I$ since I is e'- 3-S-P-I of N $\rightarrow e'.y.\subseteq I$ implies $y\in I$ since e' the identity of N $\rightarrow$ I is 3-S-P-I of N.

Remark (2.8)

In general not all x-3-S-P-I are 3-prime ideal .

Example (2.9)

considers the near ring N={ 0,1,2,3} be a near ring 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

Let $I_1=\{0,1\}$ be 2-3-semiprime ideal of N but I is not C.P.I of N, since $2.N.2=0\in I$ but $2\notin I$.

Theorem (2.10)

Let $(N_1,+,.)$ and $(N_2,+',.')$ be two near ring , $f:N_1\to N_2$ be epimomorphism and I be x- 3-S-P-I of N_1 .Then f(I) is f(x)- 3-S-P-I of N_2 .

Proof

Let I be - 3-S-P-I of N_1 f(I) is an ideal of N_2 by using theorem [1.6]
Let $c,y\in N_2$, $\exists a\in N_1$ such that $f(a)=y, f(x)=c$,hence
$f(x).'(f(a).N_2.f(a))\subseteq f(I)$ since f be an epimomorphism $f(x.(a.N_1.a))\subseteq f(I)$ since I is x-3-S-P-I of N_1
$x.(a.N_1.a)\subseteq I \to x.a\in I\to f(x.a)\in f(I)\to\to f(x).'f(a)\in f(I)$

f(x) is f(x)- 3-S-P-I of N_2 .

Theorem (2.11)

Let $(N_1,+,.)$ and $(N_2,+',.')$ be two near ring , $f:N_1\to N_2$ be epimomorphism and J be a f(x)- 3-semiprime ideal of N_2 . Then $f^{-1}(J)$ is a x-3-S-P-I of N_1 , where y= f(x) , $\ker(f)\subseteq f^{-1}(I)$.

Proof

Let $x, a\in N_1$, such that $f^{-1}(J)$ is an ideal by using theorem [1.6] ,
$x.(a.N_1.a)\subseteq f^{-1}(J)\to f(x.(a.N_1.a))\subseteq J\to f(x).'(f(a).'N_2.f(a))\subseteq J$
since J is f(x)- 3-S-P-I of N_2
$f(x).'f(a)\in J\to f(x.a)\in J\to x.a\in f^{-1}(J)$
$\to$ $f^{-1}(J)$ is a x-3-S-P-I of N_1.

Proposition (2.12)

If N is non zero near ring then I is 0-3-semiprime ideal of N.

Theorem (2.13)

Let $\{N_j\}_{j\in J}$ be a family of a near rings, $x_j \in N_j$ and I_j be x_j- 3-S-P-I of N_j for all $j \in J$. Then $\prod_{j\in J} I_j$ is (x_j)- 3-S-P-I of the direct product near ring $\prod_{j\in J} N_j$.

Proof

Let $(a_j),(x_j) \in \prod_{j\in J} N_j$,and $\prod_{j\in J} I_j$ is an ideal of $\prod_{j\in J} N_j$ by using definition (1.9) such that

$(x_j).(a_j).\prod_{j\in J} N_j.(a_j) \subseteq .\prod_{j\in J} I_j$ for all $j \in J$

$x_j.a_j.N_j.a_j \subseteq .I_j$ since I_j is x_j - 3-S-P-I of N_j for all $j \in J$

$\rightarrow x_j.a_j \in I_j \quad \forall \ j \in J \rightarrow (x_j.a_j) \in \prod_{j\in J} I_j \rightarrow (x_j).(a_j) \in \prod_{j\in J} I_j$

$\rightarrow \prod_{i\in J} I_j$ is (x_j)- 3-S-P-I of the direct product near ring $\prod_{i\in J} N_j$.

Theorem (2.14)

Let I be an ideal of the x- 3-semiprime ideal near ring N .Then the factor near ring N/I is x+I - 3-semiprime ideal near ring .

proof

The natural homomorphism $nat_I : N \rightarrow N/I$ which is defined by $nat_I(x) = x+I$, for all $x \in N$,is an epimomorphism .Now let J be an ideal of the factor near ring N/I .Then by theorem (1.6) we have $nat_I^{-1}(J)$ is an ideal of the near ring N. $\Rightarrow nat_I^{-1}(J)$ is a x-3-S-P-I of N [since N is x-3-S-P-I near ring .By theorem (2-18) we have $nat(nat_I^{-1}(J)) = J$ is nat_I (x) -3-semiprime ideal of $N/I \Rightarrow$ J is x+I –3-semiprime ideal of factor near ring .Then N/I is x+I - 3-semiprime ideal near ring .

3. 3-semiprime fuzzy ideal with respect to an element

This section is devoted to study 3-semiprime fuzzy ideal with respect to an element of a near ring.

Definition (3.1)

A fuzzy ideal μ of a near ring N is called 3- semi prime fuzzy ideal with respect to an element of anear ring N denoted by **x-3-P–F-I** for all $a \in N$

$$\mu(x.a) \geq \inf_{n \in N} \mu(x.a.n.a).$$

Example (3.2)

Consider the nar ring N={0,1,b,2} with addition and multiplication defind by the following tables .

+	0	1	b	2
0	0	1	b	2
1	1	0	2	b
b	b	2	0	1
2	2	b	1	0

.	0	1	b	2
0	0	0	0	0
1	0	1	0	1
b	0	b	0	b
2	0	2	0	2

The fuzzy ideal μ of N denoted by $\mu(y) = \begin{cases} 1 & \text{if } y \in \{0, b\} \\ 0 & \text{if } y \in \{2,1\} \end{cases}$ is an **b-3-S-P-F-I** .

Theorem (3.3)

Let μ be a fuzzy ideal of a near ring N ,and μ is a **x-3-S-P-F-I** of N then μ_t is **x-3-S-P-I** of N for all $t \in [0, \mu(0)]$.

Proof

Let $x, a, , n \in N$, x.(a.N.a)$\subseteq \mu_t \rightarrow$ x.(a.n.a) $\in \mu_t$ by using definition .(1.11),

$\mu(x.(a.n.a)) \geq t \Rightarrow \inf_{n \in N} \mu(x.(a.n.a)) \geq t$ since μ is x-3-S-P-F-I of N $\Rightarrow \mu(x.a) \geq$

$\inf_{n \in N} \mu(x.(a.n.a)) \geq t$

$\Rightarrow \mu(x.a) \geq$t, x.a $\in \mu_t \Rightarrow \mu_t$ is **x-3-S-P-I of N**.

Remark (3.4)

let f be an aepimomorphisem from the near ring N_1 onto the near ring N_2 and let μ be **x-3-S-P-F-I** of N_1 ,then f(μ_t) is a **f(x)-3-S-P-I** of N_2 .

proof

by proposition (3.3) we have μ_t is **x-3-S-P- I** of N_1 .By theorem (2.10) we get f(μ_t) is a **f(x) -3-S-P-I** of N_2.

Theorem (3.5)

Let μ be fuzzy subset of a near ring N , if μ is **x-3-S-P-I** of N, then μ_* is **x-3-S-P-I** of N.

Proof

Let $a,c,x \in N$ such that μ_* is an ideal of N $x.a.N.a \subseteq \mu_*$

$\rightarrow x.(a.n.a) \in \mu_* \Rightarrow \mu(x.(a.n.a)) = \mu(0)$ by using definition μ_* since μ is x-3-S-P-F-I of N

$\{\mu(x.a) \geq \inf_{n \in N} \mu(x.(a.n.a)) = \mu(0)$, $\mu(0) \geq \mu(y), \forall y \in N, \sin ce\ \mu\ fuzzy\ ideal, or\ \mu(x.b) = \mu(0)$

$\rightarrow x.b \in \mu_* \Rightarrow \mu_*$ is x-3-S-P-I of N.

Theorem (3.6)

Let f be an a epimorphism from the near ring N_1 onto the near ring N_2 .Then μ is f(x)-3-S-P-F-I of N_2 if $f^{-1}(\mu)$ is **x-3-S-P-F-I** of N_1,for all $x \in N$.

Proof

Let , $x,n,a \in N$, $f(x), f(n), f(a) \in N_2$,since μ is (x)-3-S-P-F-I of N_2 then

$$\mu(f(x).f(a)) \geq \inf_{n \in} \mu(f(x).(f(a).f(n).f(a)))$$

$$\mu(f(x.a)) \geq \inf_{n \in} \mu(f(x(.a.n.a)))$$

$$f^{-1}\mu(x.a) \geq \inf_{n \in} f^{-1}\mu(x.(a.n.a))$$

$\Rightarrow f^{-1}(\mu)$ is **x-3-S-P-F-I** of N_1

Corollary (3.7)

Let f be an a epimorphism from the near ring N_1 onto the near ring N_2 .Then the mapping $\mu \to f(\mu)$ defines a onto correspondence between the set of all f-invariant **x-3-S-P-F-I** of N_1 the set of all **f(x)-3-S-P-F-I** of N_2.

Proof

Directly from theorem (3.6) .

Corollary (3.8)

Let f be an a epimorphism from the near ring N_1 onto the near ring N_2 .Then μ^* Is f(x)-3-S-P-F-I of N_2 if and only if $f^{-1}(\mu)$ is an **x-3-S-P-F-I** of N_1.

Proof

By from theorem (3.6)

proposition (3.9)

let μ be a fuzzy subset of a near ring N ,then μ is **x-3-S-P-F-I** of N if and only if μ^* is **x-3-S-P-F-I** of N.

proof

$\to$let $x, a, n \in N$ since μ is x-3-S-P-F-I of N

$\mu(x.a) \geq \inf_{n \in N} \mu(x.(a.n.a)), \forall n \in N.$ since $\mu(x.a) + 1 - \mu(0) \geq \inf_{n \in N} \mu(x.(a.n.a))1 - \mu(0).$

$\mu^*(x.a) \geq \inf_{n \in N} \mu*(x.(a.n.a)) \Rightarrow \mu^*$ is x-3-S-P-F-I of N.

$\leftarrow$let μ^* is x-3-P-F-I of N.

$\mu^*(x.y) \geq \inf_{n \in N} \mu^*(x.(a.n.a))$

by using definition of μ^*

$\mu(x.a) + 1 - \mu(0) \geq \inf_{n \in N} \mu(x.(a.n.a))1 - \mu(0).$

$\mu(x.a) \geq \inf_{n \in N} \mu(x.(a.n.a)), \forall n \in N.$

$\Rightarrow \mu$ is **x-3-S-P-F-I** of N.

Theorem (3.10)

A fuzzy ideal μ of a near ring N is an x-3-S-P-F-I of N if and only if

$x_t.(a_t.n_t.a_t) \in \mu$ implies $x_t.a_t \in \mu$ for all fuzzy singleton $x_t, a_t, n_t \in N$.

Proof

$\longrightarrow$ Let $x_t, a_t, n_t \in N$. , $t \in [0, \mu(0)]$, $x_t.(a_t.n_t.a_t) \in \mu \rightarrow$

$(x.(a.n.a))_t \in \mu \rightarrow x.(a.n.a) \in \mu_t$

$\mu(x.(a.n.a)) \geq t$ since μ is x-3-S-P-F-I of N , $\mu(x.a) \geq \inf_{n \in N} \mu(x.(a.n.a)) \geq t$

$\mu(x.a) \geq t \rightarrow (x.a)_t \in \mu \rightarrow x_t.a_t \in \mu$

$\leftarrow$let $x_t, a_t, n_t \in N$. suppose that

$x_t.(a_t.n_t.a_t)) \in \mu \Rightarrow x_t.a_t \in \mu \rightarrow (x.(a.n.a))_t \in \mu$

$\Rightarrow (x.(a.n.a))_t \geq t = \inf_{n \in N} \mu(x.(a.n.a))$

$x_t.a_t \in \mu \rightarrow x_t.(a_t.n_t.a_t) \in \mu,\ \mu(x.a) \geq t$

$\mu(x.a) \geq \inf_{n \in N} \mu(x.(a.n.a)) \Rightarrow \mu$ is **x-3-S-P-F-I** of N.

Theorem (3.11)

Let $\{\mu_i\}_j \in J$ be a family of is x-3-S-P-F-I of N, then $\bigcap_{j \in J} \mu_j$ is **x-3-S-P-F-I** of N.

Proof

Let $x, a, n \in N$ and $\{\mu_i\}_j \in J$ be a famaly of x-3-S-P-F-I of N where

$$\bigcap_{j\in J} \mu_j(x.a) = \inf_{\substack{n\in N \\ j\in J}} \mu_j(x.a)$$

$$\mu_j(x.a) \geq \inf_{\substack{n\in N \\ j\in J}} \mu_j(x.(a.n.a))$$

$$\inf_{j\in J} \mu_j(x.a) \geq \inf_{j\in J}(\inf_{n\in N} \mu_j(x.(a.n.a)))$$

$$\inf_{j\in J} \mu_j(x.a) \geq \inf_{n\in N}\{\inf_{j\in J} \mu_j(x.(a.n.a)))\}$$

$$\Rightarrow \bigcap_{j\in J} \mu_j(x.a) \geq \inf_{n\in N}(\bigcap_{j\in J} \mu_j(x.(a.n.a))$$

$\Rightarrow \bigcap_{j\in J}\mu_j$ is **x-3-S-P-F-I** of N.

Remark (3.12)

Let $\{\mu_i\}_{j\in J}$ be chain of a x-3-S-P-F-I of N ,then $\bigcup_{j\in J}\mu_j$ is **x-3-S-P-F-I** of N.

Proof

By using Remark (1.14).

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