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New Types of Pseudo Ideals in Pseudo Q-algebra

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Abstract:

In this paper, we introduce the notions of Complete Pseudo Ideal, K-pseudo Ideal, Complete K-pseudo Ideal in pseudo Q-algebra. Also, we give some theorems and relationships among them are debated.

Key words: Bounded pseudo Q-algebra, pseudo ideal, pseudo Q-algebra.

Introduction:

Neggers J., Ahn. S. S., Kim H. S., at 2001 introduced the class of Q-algebras, (1). Georgescu G. and Iorgulescu A., at the same time introduced pseudo BCK-algebras as an extension of BCK-algebras, (2). Dudek. W. A. and Jun. Y. B., at 2008 introduced pseudo BCI-algebras as a natural generalization of BCI-algebras and of pseudo BCK-algebras, (3). Walendziak A., at 2015 defined pseudo BCH-algebras and considered ideals in such algebras, (4). Jun. Y. B., Kim. H. S. and Ahn. S.S., at 2016 introduced pseudo Q-algebra as a generalization of Q-algebra, and structures of pseudo ideal and pseudo atom in a pseudo Q-algebra, (5). The aim of this paper is to introduce new types of pseudo ideals and also some of theorems and we make clear it relationships with pseudo ideal in pseudo Q-algebra.

Preliminaries of Pseudo Q-algebra

In this part, definitions of pseudo Q-algebra , bounded pseudo Q-algebra, pseudo ideal, and some of their properties are presented.

Definition (2.1) (5):

A pseudo Q-algebra U is a nonempty set with a constant 0 and two binary operations $*$ and $\#$ satisfying the following axioms : for any $u, v, w \in U$

1. $u * u = u \# u = 0$
2. $u * 0 = u \# 0 = u$
3. $(u * v) \# w = (u \# w) * v$,$\forall u, v, w \in U$.

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Remark (2.2) (5):

In pseudo Q-algebra U we can define a binary operation $\leq$ by $u \leq v$ if and only if $u * v = 0$ and $u \# v = 0$, for all $u, v \in U$.

Proposition (2.3) (5),(6):

In any pseudo Q-algebra $(U, *, \#, 0)$, the following hold : for all $u, v \in U$

1. $(u * (u \# v)) \# v = (u \# (u * v)) * v = 0$.
2. $u \leq 0 \Rightarrow u = 0$.
3. $0 * (u * v) = (0 \# u) \# (0 * v)$.
4. $0 \# (u \# v) = (0 * u) * (0 \# v)$.
5. $0 * u = 0 \# u$.

Theorem (2.4) (6):

Let $(U, *, \#, 0)$ be a pseudo Q-algebra. The following statements are equivalent :

1. $u * (v * w) = (u * v) * w$, for all $u, v, w \in U$.
2. $0 * u = u = 0 \# u$, for every $u \in U$.
3. $u * v = u \# v = v * u$, for all $u, v \in U$.
4. $u \# (v \# w) = (u \# v) \# w$, for all $u, v, w \in U$.

Theorem (2.5) (6):

Every pseudo Q-algebra $(U, *, \#, 0)$ satisfying the associative law is a group under each operation $*$ and $\#$.

Definition (2.6):

Let $(U, *, \#, 0)$ be a pseudo Q-algebra, we call U is bounded if there is an element $e \in U$ satisfying $u \leq e$ for all $u \in U$, then e is called an unit of U .

In bounded pseudo Q-algebra U, we denoted $e * u$ and $e \# u$ by u^* and $u^\#$, respectively, for every $u \in U$.

Example (2.7):

Let $U = \{0, a, b, c\}$ be a set in Table 1:

Table 1. bounded pseudo Q-algebra

$*$	0	a	b	c
0	0	0	0	0
a	a	0	0	0
b	b	b	0	a
c	c	c	0	0

#	0	a	b	c
0	0	0	0	0
a	a	0	0	0
b	b	c	0	c
c	c	c	0	0

It is easy to check that $(U,*,\#,0)$ is a pseudo Q-algebra, (5). Notice that U is bounded pseudo Q-algebra with unit b.

Proposition (2.8):
In a bounded pseudo Q-algebra U, for any $u, v \in U$ the following are hold :
1. $e^* = 0 = e^\#$
2. $0^* = e = 0^\#$
3. $u^* \# v = v^\# * u$
4. $u^* \# v^* = (v^*)^\# * u$
5. $u^\# * v^\# = (v^\#)^* \# u$
6. $0 * v = 0 = 0 \# v$
7. $e^* \# u = 0 = e^\# * u$
8. $(u^*)^\# \leq u$, $(u^\#)^* \leq u$

Proof :
1. $e^* = e * e = 0 = e \# e = e^\#$
2. $0^* = e * 0 = e = e \# 0 = 0^\#$
3. $u^* \# v = (e * u) \# v = (e \# v) * u = v^\# * u$
4. $u^* \# v^* = (e * u) \# v^* = (e \# v^*) * u$
$= (v^*)^\# * u$
5. $u^\# * v^\# = (e \# u) * v^\# = (e * v^\#) \# u$
$= (v^\#)^* \# u$
6. let $v \in U$, then
$0 = (0 * v) \# e$ (since U is bounded)
$= (0 \# e) * v = 0 * v$
Also, $0 = (0 \# v) * e$ (since U is bounded)
$= (0 * e) \# v = 0 \# v$
7. $e^* \# u = 0 \# u$ (by 1)
$= 0$ (by 6)
$= 0 * u$ (by 6)
$= e^\# * u$ (by 1)
8. $(u^*)^\# * u = (e \# u^*) * u = \big(e \# (e * u)\big) * u = 0$
Also, $(u^\#)^* \# u = (e * u^\#) \# u = \big(e * (e \# u)\big) \# u = 0$

Definition (2.9) (5):
Let $(U,*,\#,0)$ be a pseudo Q-algebra and L be a nonempty subset of U. Then L is called a pseudo ideal of U if for any $u, v \in U$,
1. $0 \in L$
2. $u * v$, $u \# v \in L$ and $v \in L$ imply $u \in L$.

Proposition (2.10) (5):
Let L be a pseudo ideal of a pseudo Q-algebra U. If $u \in L$ and $v \leq u$, then $v \in L$.

The Main Results
In this part , we provide definitions of complete pseudo ideal , K-pseudo ideal , complete K-pseudo ideal and study its relationships with pseudo ideal in bounded pseudo Q-algebra .

Definition (3.1):
A nonempty subset L of a bounded pseudo Q-algebra U is called complete pseudo ideal (briefly, c-pseudo ideal) , if
1. $0 \in L$
2. $u * v$, $u \# v \in L$, $\forall v \in L$ such that $v \neq 0$ implies $u \in L$.

Example (3.2):
Let $U = \{0, a, b, c\}$ and two binary operations $*$ and # defined by Table 2 :

Table 2. bounded pseudo Q-algebra

$*$	0	a	b	c
0	0	0	0	0
a	a	0	0	0
b	b	0	0	c
c	c	c	0	0

#	0	a	b	c
0	0	0	0	0
a	a	0	0	a
b	b	b	0	a
c	c	c	0	0

Then $(U,*,\#,0)$ is a bounded pseudo Q-algebra with unit b. A subset $L = \{0, a, c\}$ is c-pseudo ideal of U. While $= \{0, b\}$ is not c-pseudo ideal, because $a * b = a \# b = 0 \in M$, $b \in M$ and $b \neq 0$ but $a \notin M$.

Remark (3.3):
In general , $\{0\}$ and U are called trivial c-pseudo ideals .

Proposition (3.4):
Every pseudo ideal of bounded pseudo Q-algebra is c-pseudo ideal .

Proof :
Suppose that L is a pseudo ideal from a bounded pseudo Q-algebra U and $u * v$, $u \# v \in L$, $\forall v \in L$ such that $v \neq 0$
1. If $L = \{0\}$, then L is c-pseudo ideal .
2. If $L \neq \{0\}$, thereafter $\exists v \in L$ such that $v \neq 0$. Thus $u \in L$ (Since L is pseudo ideal). Hence L is c-pseudo ideal.

Note that, in general, the converse of this proposition is not correct and the following example shows that .

Example (3.5):
In Example (3.2), the subset $L = \{0, a, c\}$ is a c-pseudo ideal , while L is not pseudo ideal , because $b * c = c \in L$, $b \# c = a \in L$ and $c \in L$ but $b \notin L$.

Definition (3.6):
Let $(U, *, \#, 0)$ be a bounded pseudo Q-algebra and L be a nonempty subset of U. Then L is called K*-pseudo ideal of U (resp. K#-pseudo ideal of), if
1. $0 \in L$
2. $u^* * v$, $v^\# * u \in L$ (resp. $u^\# \# v$, $v^* \# u \in L$) and $v \in L$ implies $u^* \in L$ (resp . $u^\# \in L$) , for all $u \in U$.
Then L is called K-pseudo ideal of U , if L is K*-pseudo ideal and K#-pseudo ideal of U.

Example (3.7):
Let $U = \{0, a, b, c, d\}$. Define the binary operations $*$ and $\#$ on U by Table 3 :

Table 3. bounded pseudo Q-algebra

$*$	0	a	b	c	d
0	0	0	0	0	0
a	a	0	0	0	a
b	b	0	0	b	b
c	c	0	c	0	b
d	d	0	d	0	0

$\#$	0	a	b	c	d
0	0	0	0	0	0
a	a	0	0	a	a
b	b	0	0	0	0
c	c	0	d	0	d
d	d	0	d	0	0

Then $(U, *, \#, 0)$ is a bounded pseudo Q-algebra with unit a.
A subset $L = \{0, a\}$ is K-pseudo ideal of U. While $M = \{0, b\}$ is not K-pseudo ideal, because $0^* * b = b^\# * 0 = 0 \in M$, $b \in M$ however $0^* = a \notin M$.

Remark (3.8):
In bounded pseudo Q-algebra , a K*-pseudo ideal needs not be K#-pseudo ideal, as well a K#-pseudo ideal needs not be K*-pseudo ideal as showing in the following example.

Example (3.9):
Let $U = \{0, a, b, c\}$ and two binary operations $*$ and $\#$ defined by Table 4 :

Table 4. bounded pseudo Q-algebra

$*$	0	a	b	c
0	0	0	0	0
a	a	0	0	a
b	b	c	0	b
c	c	c	0	0

$\#$	0	a	b	c
0	0	0	0	0
a	a	0	0	0
b	b	b	0	a
c	c	c	0	0

Then $(U, *, \#, 0)$ is a bounded pseudo Q-algebra with unit b. A subset $L = \{0, b, c\}$ is a K*-pseudo ideal of, but it's not K#-pseudo ideal, because $c^\# \# b = b^* \# c = 0 \in L$, $b \in L$ however $c^\# = a \notin L$.
Also $M = \{0, a, b\}$ is a K#-pseudo ideal of U, but it's not K*-pseudo ideal, because $a^* * b = b^\# * a = 0 \in M$, $b \in M$ however $a^* = c \notin M$.

Definition (3.10):
Let U be bounded pseudo Q-algebra. An element $u \in U$ satisfies $u^{**} = u = u^{\#\#}$, then u is called an involution (i.e u is $*$-involution and #-involution). If every element $u \in U$ is an involution, we call U is an involutory pseudo Q-algebra .

Example (3.11) :
Let $U = \{0, a, b, c, d\}$. Define the binary operations $*$ and $\#$ on U by Table 5 :

Table 5. involutory pseudo Q-algebra

$*$	0	a	b	c	d
0	0	0	0	0	0
a	a	0	0	0	0
b	b	d	0	0	0
c	c	a	d	0	b
d	d	0	0	0	0

$\#$	0	a	b	c	d
0	0	0	0	0	0
a	a	0	d	0	0
b	b	0	0	0	0
c	c	d	b	0	a
d	d	0	0	0	0

Then $(U, *, \#, 0)$ is a bounded pseudo Q-algebra with unit c. Notice that U is an involutory.

Theorem (3.12):
Let L be a subset of an involutory pseudo Q-algebra U. Then the following statements are equivalent :
1. L is a K*-pseudo ideal
2. L is a K#-pseudo ideal

Proof :
$1 \Longrightarrow 2$: let L be K*-pseudo ideal of U and $u^\# \# v$, $v^* \# u \in L$ & $v \in L$
Since U is $*$-involutory, then $u^\# \# v = (u^\#)^{**} \# v = v^\# * (u^\#)^*$ and $v^* \# u = u^\# * v = (u^\#)^{**} * v$. Thus $(u^\#)^{**} * v$, $v^\# * (u^\#)^* \in L$.

Since L is K*-pseudo ideal and $v \in L$, then $(u^{\#})^{**} \in L$ i.e $u^{\#} \in L$

Hence L is a K#-pseudo ideal of U.

$2 \Longrightarrow 1$: let L be K#-pseudo ideal of U and $u^* * v$, $v^{\#} * u \in L$ & $v \in L$

Since U is #-involutory, then $u^* * v = (u^*)^{\#\#} * v = v^* \# (u^*)^{\#}$ and

$v^{\#} * u = u^* \# v = (u^*)^{\#\#} \# v$. Thus $(u^*)^{\#\#} \# v$, $v^* \# (u^*)^{\#} \in L$. Since L is K#-pseudo ideal and $v \in L$, then $(u^*)^{\#\#} \in L$ i.e $u^* \in L$.

Hence L is a K*-pseudo ideal of U.

Proposition (3.13):

Every pseudo ideal of bounded pseudo Q-algebra is K-pseudo ideal .

Proof :

Assume that L be a pseudo ideal in a bounded pseudo Q-algebra U such that $u^* * v$, $v^{\#} * u \in L$ and $v \in L$. Since $v^{\#} * u = u^* \# v$. Thus $u^* * v$, $u^* \# v \in L$ and $v \in L$. Since L is pseudo ideal, then $u^* \in L$. Thus L is a K*-pseudo ideal of U.

Similarly, if $u^{\#} \# v$, $v^* \# u \in L$, $v \in L$ we get $u^{\#} \in L$. Thus L is K#-pseudo ideal of U. Hence L is K-pseudo ideal of U.

Note that the converse of this proposition needs not be true and we can show that in the following example.

Example (3.14):

In Example (3.7), a subset $L = \{0, a\}$ is K-pseudo ideal of U, but it's not pseudo ideal, since $b * a = b \# a = 0 \in L$ and $a \in L$ but $b \notin L$.

Proposition (3.15):

If L is K-pseudo ideal of an involutory pseudo Q-algebra U. Then L is a pseudo ideal .

Proof :

Assume that L be K-pseudo ideal of U, then L is K*-pseudo ideal and K#-pseudo ideal of U. Thus L is K*-pseudo ideal and L is K#-pseudo ideal are equivalent (since U is involutory pseudo Q-algebra) . To prove L is pseudo ideal of U

Let $u * v$, $u \# v \in L$ and $v \in L$

Since U is $*$-involutory, then $u * v = u^{**} * v$ and $u \# v = u^{**} \# v = v^{\#} * u^*$. Thus $u^{**} * v$, $v^{\#} * u^* \in L$ and $v \in L$. But L is K*-pseudo ideal, then $u^{**} \in L$ i.e $u \in L$. Hence L is pseudo ideal of U.

Proposition (3.16):

Let L be K-pseudo ideal of a bounded pseudo Q-algebra U. Then

1. If $u^* \leq v$ and $v \in L$ implies $u^* \in L$.
2. If $u^{\#} \leq v$ and $v \in L$ implies $u^{\#} \in L$.

Proof :

Let L be K-pseudo ideal of U, then L is K*-pseudo ideal and K#-pseudo ideal of U

1. If $u^* \leq v$. Then $u^* * v = 0$ and $u^* \# v = 0$ But $u^* \# v = v^{\#} * u$, thus $u^* * v$, $v^{\#} * u \in L$. Since L is K*-pseudo ideal & $v \in L$, then $u^* \in L$.
2. Similarly, if $u^{\#} \leq v$ and $v \in L$ we get $u^{\#} \in L$.

Proposition (3.17):

Let L be K-pseudo ideal of a bounded pseudo Q-algebra U,

1. If $e \in L$, then $u^*, u^{\#} \in L$, for all $u \in U$.
2. If $u \in L$ and $u^* = 0 = u^{\#}$, then $e \in L$.

Proof :

1. Since L is K*-pseudo ideal of U and $e \in L$, then for all $u \in U$ $u^* * e = 0 \in L$ and $e^{\#} * u = 0 * u = 0 \in L$. Thus $u^* \in L$.
Similarly, if L is K#-pseudo ideal of U and $e \in L$, we get $u^{\#} \in L$.
2. Since L is K*-pseudo ideal of U and $u \in L$ such that $u^* = 0 = u^{\#}$, then $0^* * u = u^* = 0 \in L$ and $u^{\#} * 0 = u^{\#} = 0 \in L$. Thus $e = 0^* \in L$.

Definition (3.18):

A nonempty subset L of a bounded pseudo Q-algebra U is called complete K*-pseudo ideal of U (resp. complete K#-pseudo ideal of), briefly, c-K*-pseudo ideal (resp. c-K#-pseudo ideal), if

1. $0 \in L$
2. $u^* * v$, $v^{\#} * u \in L$ (resp. $u^{\#} \# v$, $v^* \# u \in L$) $\forall\, v \in L$ such that $v \neq 0$ implies $u^* \in L$ (resp . $u^{\#} \in L$), $\forall\, u \in U$.

Then L is called c-K-pseudo ideal of U, if L is c-K*-pseudo ideal and c-K#-pseudo ideal.

Note that in bounded pseudo Q-algebra , there are trivial c-K-pseudo ideals , $\{0\}$ and U .

Example (3.19):

In Example (2.7), a subset $L = \{0, a, c\}$ is a c-K-pseudo ideal of U .

Remark (3.20):

In bounded pseudo Q-algebra , a c-K*-pseudo ideal needs not be c-K#-pseudo ideal, as well a c-K#-pseudo ideal needs not be c-K*-pseudo ideal as showing in the following examples.

Example (3.21):

Let $U = \{0, a, b, c\}$ be a set in Table 6 :

Table 6. bounded pseudo Q-algebra

$*$	0	a	b	c
0	0	0	0	0
a	a	0	0	0
b	b	b	0	0
c	c	b	b	0

$\#$	0	a	b	c
0	0	0	0	0
a	a	0	0	0
b	b	0	0	0
c	c	a	a	0

Then $(U,*,\#,0)$ is a bounded pseudo Q-algebra with unit c. If $L=\{0,b,c\}$, then L is a c-K*-pseudo ideal of U. But L is not c-K$^\#$-pseudo ideal of U, because $a^\# \# v = v^* \# a = 0 \in L, \forall v \in L$ and $v \neq 0$ however $a^\# = a \notin L$.

Example (3.22):

In Example (2.7), A subset $M=\{0,b,c\}$ is a c-K$^\#$-pseudo ideal of U.

But M is not c-K*-pseudo ideal of U, because $c^* * v = v^\# * c = 0 \in M$, $\forall v \in M$ such that $v \neq 0$ however $c^* = a \notin M$.

Theorem (3.23):

Let L be a subset of an involutory pseudo Q-algebra U. Then the following statements are equivalent :

1. L is a c-K*-pseudo ideal
2. L is a c-K$^\#$-pseudo ideal

Proof :

Similarly with equivalence K*-pseudo ideal and K$^\#$-pseudo ideal.

Proposition (3.24):

Every K-pseudo ideal of bounded pseudo Q-algebra is c-K-pseudo ideal.

Proof :

Let L be K-pseudo ideal in bounded pseudo Q-algebra U, then L is K*-pseudo ideal and K$^\#$-pseudo ideal.

1. If $L=\{0\}$, thus L is a c-K-pseudo ideal .
2. If $L \neq \{0\}$,

(i) Let $u^* * v,\ v^\# * u \in L, \forall v \in L$ and $v \neq 0$, thereafter $\exists v \in L\ \&\ v \neq 0$. Since L is K*-pseudo ideal & $u^* * v,\ v^\# * u \in L$, then $u^* \in L$. Thus L is a c-K*-pseudo ideal.

(ii) Similarly , if $u^\# \# v,\ v^* \# u \in L, \forall v \in L$ such that $v \neq 0$, we get $u^\# \in L$.

Thus L is a c-K$^\#$-pseudo ideal. Hence L is c-K-pseudo ideal of U.

Note that the converse of this proposition needs not be true in general as shown in the following example .

Example (3.25):

In Example (3.19), a subset $L=\{0,a,c\}$ is c-K-pseudo ideal , but it's not K-pseudo ideal, because $0^* * c = a \in L$, $c^\# * 0 = c \in L$ and $c \in L$ however $0^* = b \notin L$.

Proposition (3.26):

Let L be c-K-pseudo ideal in a bounded pseudo Q-algebra U. If $u^* \leq v$ and $u^\# \leq v$, $\forall v \in L$ such that $v \neq 0$. Then L is K-pseudo ideal of U.

Proof :

Assume that L be c-K-pseudo ideal in U, then L is c-K*-pseudo ideal and c-K$^\#$-pseudo ideal in U.

1. Let $u^* * v,\ v^\# * u \in L,\ v \in L$ such that $v \neq 0$

Since $u^* \leq v$, then $u^* * v = 0$ and $u^* \# v = 0$ But $u^* \# v = v^\# * u$. Thus $u^* * v = v^\# * u = 0 \in L, \forall v \in L$ such that $v \neq 0$. Since L is c-K*-pseudo ideal , thereafter $u^* \in L$. Thus L is K*-pseudo ideal of U.

2. Similarly , if $u^\# \# v,\ v^* \# u \in L,\ v \in L$ such that $v \neq 0$, we get $u^\# \in L$.

Thus L is K$^\#$-pseudo ideal of U. Hence L is a K-pseudo ideal of U.

Corollary (3.27):

Every pseudo ideal of bounded pseudo Q-algebra is a c-K-pseudo ideal .

Proposition (3.28):

Any c-pseudo ideal from bounded pseudo Q-algebra is a c-K-pseudo ideal.

Proof :

Let L be c-pseudo ideal from a bounded pseudo Q-algebra U and $u^* * v,\ v^\# * u \in L, \forall v \in L$ such that $v \neq 0$. Since $u^* \# v = v^\# * u$, implies $u^* * v,\ u^* \# v \in L, \forall v \in L$ such that $v \neq 0$. Since L is c-pseudo ideal from U, then $u^* \in L$. Thus L is c-K*-pseudo ideal.

Similarly , if $u^\# \# v,\ v^* \# u \in L, \forall v \in L$ such that $v \neq 0$, we get $u^\# \in L$.

Thus L is c-K$^\#$-pseudo ideal. Hence L is c-K-pseudo ideal of U.

In general, the inverse of this proposition needs not be true as shown in the following example.

Example (3.29):

In Example (3.7), if $L=\{0,a,c\}$, then L is a c-K-pseudo ideal of U, while L is not c-pseudo ideal , because $d * w = d \# w = 0 \in L$, $\forall w \in L$ and $w \neq 0$ but $d \notin L$.

Proposition (3.30):

If L be c-K-pseudo ideal in an involutory pseudo Q-algebra U, then L is c-pseudo ideal .

Proof :

Suppose that L be c-K-pseudo ideal of U, then L is c-K*-pseudo ideal and c-K$^\#$-pseudo ideal of U. Thus L is c-K*-pseudo ideal and L is c-K$^\#$-pseudo ideal are equivalent (since U is an involutory pseudo Q-algebra). To prove L is c-pseudo ideal of U. Let $u * v,\ u \# v \in L, \forall v \in L$ such that $v \neq 0$. Since U is $*$-involutory, then $u * v = u^{**} * v$ and $v^\# * u^* = u^{**} \# v = u \# v$. Thus $u^{**} * v,\ v^\# * u^* \in L, \forall v \in L$ such that $v \neq 0$. Since L is c-K*-pseudo ideal, then $u^{**} \in L$, i.e , $u \in L$. Hence L is a c-pseudo ideal of U.

Remark (3.31):

The diagram in (Fig. 1) shows the relations among pseudo ideal, K-pseudo ideal, c-pseudo ideal, and c-K-pseudo ideal in bounded pseudo Q-algebra :

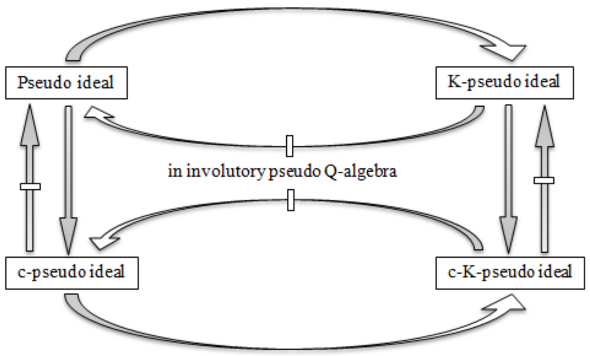

Figure 1. The relations among pseudo ideals in bounded pseudo Q-algebra.

Future Works

There are many avenues that one could explore. In this section, we state some of these open problems and conjectures.

1. Studying the Fuzzy pseudo ideal of pseudo Q-algebra.
2. Studying the Fuzzy complete pseudo ideal (as a generalization of fuzzy pseudo ideal) of pseudo Q-algebra.
3. Studying the Fuzzy K-pseudo ideal (as a generalization of fuzzy pseudo ideal) of pseudo Q-algebra.
4. Studying the Fuzzy complete K-pseudo ideal (as a generalization of fuzzy K-pseudo ideal and fuzzy complete pseudo ideal) of pseudo Q-algebra.
5. Trying to study these pseudo ideals on other algebras in the two cases (Ordinary and Fuzzy).

Conflicts of Interest: None.

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انواع جديدة من المثاليات الكاذبة في جبر-Q الكاذب

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الخلاصة :
في هذا البحث قدمنا المفاهيم لمكمل المثالي الكاذب ، مثالي-K الكاذب ، مكمل مثالي-K الكاذب في جبر-Q الكاذب. كذلك نعطي بعض الخواص و العلاقات التي تناقش فيما بينها .

الكلمات المفتاحية : جبر-Q الكاذب ، جبر-Q الكاذب المقيد ، المثالي الكاذب .