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ON Q-FUZZY SOFT RING AND Q-FUZZY SOFT IDEAL

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ABSTRACT

As a new algebraic structure , Q-fuzzy groups were introduced by Solairajee and Nagaranjan in 2009 . Fuzzy soft rings and fuzzy soft ideals were introduced by Ghosh , Dinda and Samanta in 2011 .

In this paper , we introduce Q-fuzzy soft ring and Q- fuzzy soft ideal by using fuzzy soft sets . Several algebraic properties together with homomorphic image and pre image are investigated.

KEY WORD : Fuzzy soft sets , Fuzzy soft ring , Fuzzy soft ideal , Q-fuzzy soft ring , Q-fuzzy soft ideal

1. INTRODUCTION

Fuzzy set theory developed by Zadeh [3] is considered as a special case of soft sets. Due to the lack of parameterization, Zadeh's fuzzy set theory was not successful in some cases . It is for this reason that Molodstov [5] introduced the concept of soft sets in 1999 as a new mathematical tool for dealing with uncertainties.

Ahamad and Kharal [6] introduced the definition of fuzzy soft set and studied some of their basic properties . Zhiming Zhang [7] studied intuitionistic fuzzy soft ring .

Solairajee and Nagaranjan [1] and [9] analyzed Q- fuzzy groups and introduced fuzzy left R-subgroups of near rings with respect to t-norm . Ghosh , Dinda and Samanta [2]introduced the concept of fuzzy soft rings and fuzzy soft ideals .

In our paper , we have developed the concept of Q-fuzzy soft ring and Q-fuzzy soft ideal by the help of fuzzy soft sets . Some algebraic properties as well as homomorphic image and pre image have also been studied .

2. PRELIMINARIES :

DEF(2.1) : A fuzzy set Ã on a non empty set X is characterized by its membership function , $\mu_{\tilde{A}} : X \to [0,1]$ where $\mu_{\tilde{A}}(x)$ is interpreted as the degree of membership of element of X in fuzzy set Ã for all $x \in X$. The complement of fuzzy set Ã on X is defined by

$$\tilde{A}^c = 1 - \mu_{\tilde{A}}(x) \quad .$$

The null fuzzy set Õ and the whole fuzzy set Ĩ are constant mapping from X to {0}and {1} respectively . [3]

DEF(2.2) The standard intersection of two fuzzy sets $\tilde{A}$ and $\tilde{B}$ is represented in general by binary operation $i:[0,1]\times[0,1]\rightarrow[0,1]$ on unit interval called t-norm which satisfies the following conditions .

(i) i is commutative and associative .

(ii) i is continuous .

(iii) $i(a,1)=a \quad ; \quad \forall a\in[0,1]$

(iv) $a\le c \;;\; b\le d \;\Rightarrow\; i(a,b)\le i(c,d); \quad \forall a,b,c,d\in[0,1]$

[4]

DEF(2.3) : The standard union of two fuzzy sets $\tilde{A}$ and $\tilde{B}$ is represented in general by binary operation $u:[0,1]\times[0,1]\rightarrow[0,1]$ on unit interval called t- co norm which satisfied the following condition .

(i) u is a commutative and associative

(ii) u is a continuous

(iii) $u(a,0)=a \quad ; \quad \forall a\in[0,1]$

(iv) $a\le c \;;b\le d \quad\Rightarrow\quad u(a,b)\le u(c,d) \qquad \forall a,b.c.d\in[0,1]$ [4]

DEF(2.4) : Let X be the universal set of discourse, E be the set of parameter and P(X) be the power set of X. .Then the ordered pair (F,E) , where $F:E\rightarrow P(X)$, is a mapping , is called a soft set over X .

In fact a soft set is a parameterized family of subsets of X , where each set $\{F(p):p\in E\}$ of the family is a collection of p element of the soft set (F,E). [5]

DEF(2.5) : Let X be the universal set , E be the set of parameter and $A\subseteq E$

Then the pair (F,A) where $F:A\rightarrow I^X$ is a mapping and I=[0,1] is called a fuzzy soft set on X , I^X being the collection of all fuzzy subsets of X . [6]

DEF(2.6) : Let G be the group and (F,A) be the soft set over G . Then (F,A) is said to be soft group over G iff $F(p)<G$ for each $p\in A$

DEF(2.7) : Let G be group and (F,A) be a fuzzy soft set over G .Then (F,A) is said to be a fuzzy soft group over G , iff for each $p\in A$ and $x,y\in G$

(i) $F_p(x,y)\ge i[F_p(x),F_p(y)]$

(ii) $F_p(x^{-1})\ge F_p(x)$

DEF(2.8) : Let f and g be any two fuzzy subsets of a ring .Then $u(f,g)$ is also a fuzzy subset of R

defined by $u(f,g)(z)=\begin{cases}\bigvee_{z=xy}[\min\{f(x),g(y)\}] & ; \quad z=xy.\\ 0 & ; \quad z\ne xy.\end{cases}$ where $x,y,z\in R.$

DEF(2.9) : Let (F,A) be a soft set over a ring $(R,+,\cdot)$ .Then (F,A) is called a soft ring over R iff $F(p)$ is a subring of R for all $p\in A$

DEF(2.10) : Let R be the soft ring .Then a fuzzy set $\mu_{\tilde{A}}:R\rightarrow[0,1]$ on R is called a fuzzy soft ring on R if

(i) $\mu_{\tilde{A}}(x+y)\ge i\{\mu_{\tilde{A}}(x),\mu_{\tilde{A}}(y)\}$

(ii) $\mu_{\tilde{A}}(-x)\ \ge\ \mu_{\tilde{A}}(x)$

(iii) $\mu_{\tilde{A}}(xy)\ge\ i\{\mu_{\tilde{A}}(x),\mu_{\tilde{A}}(y)\}$, for all $x,y,\in R$ xy stands for $x.y$ and i is t-norm

DEF(2.11) : Let $(f,g): X \to Y$ be a fuzzy soft function . if $f: X \to Y$ be a homomorphism , then (f,g) is called a fuzzy soft homomorphism and if $f: X \to Y$ be an isomorphism and $g: X \to Y$ be one one mapping from A onto B , then (f,g) is called a fuzzy soft isomorphism , where $A \subset X$, $B \subset Y$

3 : Q-FUZZY SOFT RINGS

DEF(3.1) : Let R be the soft ring . A fuzzy set $\mu_{\tilde{A}}(x)$ where $\tilde{A} = \{x, \mu_{\tilde{A}}(x) : x \in R\}$ on R is called Q- fuzzy soft ring in R if following conditions hold .

Q1 : $\mu_{\tilde{A}}(x+y,q) \geq i\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$

Q2 : $\mu_{\tilde{A}}(-x,q) \geq \mu_{\tilde{A}}(x,q)$

Q3 : $\mu_{\tilde{A}}(x.y,q) \geq i\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$ for all $x, y \in R$ and $q \in Q$

Theorem (3.2) : Every assumed Q-fuzzy soft ring $\mu_{\tilde{A}}(x)$ is a Q-fuzzy soft ring of R .

Proof : Let $\mu_{\tilde{A}}$ be an assumed Q-fuzzy soft ring

Q1 : $\mu_{\tilde{A}}(x+y,q) \geq i\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$

Q2 : $\mu_{\tilde{A}}(-x,q) \geq \mu_{\tilde{A}}(x,q)$

Q3 : $\mu_{\tilde{A}}(x.y,q) \geq i\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$ for all $x, y \in R$ and $q \in Q$

Since $\mu_{\tilde{A}}(x)$ is assumed

$$\wedge\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\} = i\,[\wedge\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\} ; \wedge\mu_{\tilde{A}}(x,q), \wedge\mu_{\tilde{A}}(y,q)]$$
$$\leq i\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$$
$$\leq \wedge\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$$

And hence ,

$$i\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\} = \wedge\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$$

$$\Rightarrow \mu_{\tilde{A}}(x+y,q) \geq i\{\mu_{\tilde{A}}(x,q), \mu_{\tilde{A}}(y,q)\}$$
$$= \min\{\mu_{\tilde{A}}(x,q) , \mu_{\tilde{A}}(y,q)\}$$ for all $x, y \in R$ and $q \in Q$

Hence $\mu_{\tilde{A}}(x)$ is a Q- fuzzy soft ring of R .

Theorem (3.3) Let $\mu_{\tilde{A}}(x)$ be the Q- fuzzy soft ring of R and ϕ be an endomorphism of R , then $\mu_{\tilde{A}}(\phi)$ is also Q- fuzzy soft ring R .

Proof : for all $x, y \in R$, we have

Q_1 : $$\mu_{\tilde{A}}(\phi)\{(x+y,q)\} = \mu_{\tilde{A}}\{\phi(x+y,q)\}$$
$$\geq \mu_{\tilde{A}}\{\phi(x,q) , \phi(y,q)\}$$
$$\geq i\{\mu_{\tilde{A}}\phi(x,q) , \mu_{\tilde{A}}\phi(y,q)\}$$
$$\geq i\{(\mu_{\tilde{A}}\phi)(x,q) , (\mu_{\tilde{A}}\phi)(y,q)\}$$

Q_2 : $$\mu_{\tilde{A}}(\phi)(-x,q) = \mu_{\tilde{A}}\{\phi(-x,q)\}$$
$$\geq \mu_{\tilde{A}}\{\phi(x,q)\}$$
$$\geq \mu_{\tilde{A}}(\phi)(x,q)$$

Q_3 : $\mu_{\tilde{A}}(\phi)\{(x.y,q)\} = \mu_{\tilde{A}}\{\phi(xy,q)\}$

$= \mu_{\tilde{A}}\{(\phi x,q),(\phi y,q)\}$

$\geq i\{\mu_{\tilde{A}}(\phi x,q),\mu_{\tilde{A}}(\phi y,q)\}$

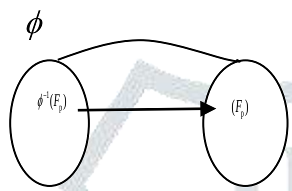
$\geq i\{\mu_{\tilde{A}}\phi(x,q),\mu_{\tilde{A}}\phi(y,q)\}$

$\Rightarrow \mu_{\tilde{A}}(\phi)$ is a Q- fuzzy soft ring of R

Theorem (3.4) : Let R and $R^{/}$ be two rings and $\phi : R \rightarrow R^{/}$ be a soft homomorphism.

if $\mu_{\tilde{A}}$ and F_p be Q- fuzzy soft rings of R and $R^{/}$ respectively. Then the pre image $\phi^{-1}(F_p)$ is a Q- fuzzy soft ring of R

Proof : Suppose that F_p is a Q – fuzzy soft ring of $R^{/}$, Such that $x, y \in R$ and $q \in Q$



R $R^{/}$

Then Q_1 : $\mu_{\tilde{A}\phi^{-1}(F_p)}\{(x+y,q)\} = \mu_{\tilde{A}(F_p)}\{\phi(x+y),q\}$

$= \mu_{\tilde{A}(F_p)}\{(\phi x,q),(\phi y,q)\}$

$\geq i\ \{\mu_{\tilde{A}(F_p)}(\phi(x,q)),\ \mu_{\tilde{A}(F_p)}(\phi(y,q))\}$

$\geq i\ \{\ \mu_{\tilde{A}\phi^{-1}(F_p)}(x,q)\ ,\ \mu_{\tilde{A}\phi^{-1}(F_p)}(y,q)\}$

Q_2 : $\mu_{\tilde{A}\phi^{-1}(F_p)}\{(-x,q)\} = \mu_{\tilde{A}(F_p)}\{\phi(-x,q)\}$

$\geq \mu_{\tilde{A}(F_p)}\{\phi(x,q)\}$

$\geq \mu_{\tilde{A}\phi^{-1}(F_p)}\{(x,q)\}$

Q_3 : $\mu_{\tilde{A}\phi^{-1}(F_p)}\{(xy,q)\} = \mu_{\tilde{A}(F_p)}\{\phi(xy,q)\}$

$= \mu_{\tilde{A}(F_p)}\{(\phi x,q),(\phi y,q)\}$

$\geq i\ \{\mu_{\tilde{A}(F_p)}(\phi(x,q)),\ \mu_{\tilde{A}(F_p)}(\phi(y,q))\}$

$\geq i\ \{\ \mu_{\tilde{A}\phi^{-1}(F_p)}(x,q)\ ,\ \mu_{\tilde{A}\phi^{-1}(F_p)}(y,q)\}$

$\Rightarrow \phi^{-1}(F_p)$ is a Q – fuzzy soft ring of R

Theorem (3.5) : The onto homomorphism image of a Q- fuzzy soft ring having suprimum Property is a Q - fuzzy soft ring of R

Proof : Let $\phi : R \rightarrow R^{/}$ be an onto homomorphism of Q- fuzzy soft rings and μ be the Suprimum Property of Q-fuzzy soft ring of R .

Let $x^{/}, y^{/} \in R^{/}$ and $x_0 \in \phi^{-1}(x^{/})$, $y_0 \in \phi^{-1}(y^{/})$ be such that

$$\mu_{\tilde{A}}(x_0,q) = \sup_{(h,q)\in\phi^{-1}(x^{/})} \{\mu_{\tilde{A}}(h,q)\}$$

and $\mu_{\tilde{A}}(y_0,q) = \sup_{(h,q)\in\phi^{-1}(y^{/})} \{\mu_{\tilde{A}}(h,q)\}$ respectively.

Then we can deduce that

$$Q_1 : \mu_{\tilde{A}}^{/}\{(x^{/}+y^{/},q)\} = \sup_{(z,q)\in\phi^{-1}(x^{/}+y^{/},q)} \{\mu_{\tilde{A}}(z,q)\}$$

$$\geq i\ \{\mu_{\tilde{A}}(x_0,q),\mu_{\tilde{A}}(y_0,q))$$

$$\geq i\ \{ \sup_{(h,q)\in\phi^{-1}(x^{/},q)} \mu_{\tilde{A}}(h,q)\ ,\ \sup_{(h,q)\in\phi^{-1}(y^{/},q)} \mu_{\tilde{A}}(h,q)\ \}$$

$$\geq \min\{\mu_{\tilde{A}}^{/}(x^{/},q),\mu_{\tilde{A}}^{/}(y^{/},q)\}$$

$$Q_2 : \mu_{\tilde{A}}^{/}(-x^{/},q) = \sup_{(z,q)\in\phi^{-1}(-x^{/},q)} \{\mu_{\tilde{A}}(z,q)\}$$

$$\geq \mu_{\tilde{A}}(x_0,q) =$$

$$\geq \sup_{(h,q)\in\phi^{-1}(x^{/},q)} \mu_{\tilde{A}}(h,q)$$

$$= \mu_{\tilde{A}}(x^{/},q)$$

$$Q_3 : \mu_{\tilde{A}}^{/}\{(x^{/}y^{/},q)\} = \sup_{(z,q)\in\phi^{-1}(x^{/}y^{/},q)} \{\mu_{\tilde{A}}(z,q)\}$$

$$\geq i\ \{\mu_{\tilde{A}}(x_0,q),\mu_{\tilde{A}}(y_0,q))$$

$$\geq i\ \{ \sup_{(h,q)\in\phi^{-1}(x^{/},q)} \mu_{\tilde{A}}(h,q)\ ,\ \sup_{(h,q)\in\phi^{-1}(y^{/},q)} \mu_{\tilde{A}}(h,q)\ \}$$

$$= \min\{\mu_{\tilde{A}}^{/}(x^{/},q),\mu_{\tilde{A}}^{/}(y^{/},q)\}$$

Hence , $\mu_{\tilde{A}}$ is a Q-fuzzy soft ring of $R^{/}$

Theorem (3.6) : Let $\mu_{\tilde{A}}$ be a Q – fuzzy soft set of R and $\mu_{\tilde{A}}^{*}$ be a Q- fuzzy set in N ={1,2,3……} defined by $\mu_{\tilde{A}}^{*}(x,q) = \mu_{\tilde{A}}(x,q)+1-\mu_{\tilde{A}}(o,q)$, for all $x\in N$

Then $\mu_{\tilde{A}}^{*}$ is a normal Q –fuzzy subgroup of R

Proof : - For any $x,y\in R$ and $q\in Q$ we have ,

$$Q_1 : \mu_{\tilde{A}}^{*}\{(x+y),q\} = \mu_{\tilde{A}}(x+y,q) +1 - \mu_{\tilde{A}}(o,q)$$

$$\geq i\{\mu_{\tilde{A}}(x,q),\mu_{\tilde{A}}(y,q)\} +1 - \mu_{\tilde{A}}(o,q)$$

$$\geq i\{\mu_{\tilde{A}}(x,q)+1-\mu_{\tilde{A}}(o,q),\mu_{\tilde{A}}(y,q)+1-\mu_{\tilde{A}}(o,q)\}$$

$$= i\{\mu_{\tilde{A}}^{*}(mx,q),\mu_{\tilde{A}}^{*}(my,q)\}$$

$$Q_2 : \mu_{\tilde{A}}^{*}(-x,q) = \mu_{\tilde{A}}(-x,q)+1-\mu_{\tilde{A}}(o,q)$$

$$\geq \{\mu_{\tilde{A}}(x,q)+1-\mu_{\tilde{A}}(o,q)\}$$

$$= \mu_{\tilde{A}}^{*}(x,q)$$

$$= i\{\mu_{\tilde{A}}^{*}(mx,q),\mu_{\tilde{A}}^{*}(my,q)\}$$

$$Q_3 : \mu_{\tilde{A}}^{*}(xy,q) = \mu_{\tilde{A}}(xy,q)+1-\mu_{\tilde{A}}(o,q)$$

$$\geq i[\{\mu_{\tilde{A}}(x,q),\mu_{\tilde{A}}(y,q)\} +1 - \mu_{\tilde{A}}(o,q)]$$

$$\geq i[\{\mu_{\tilde{A}}(x,q)+1-\mu_{\tilde{A}}(o,q)\} , \{\mu_{\tilde{A}}(y,q)+1-\mu_{\tilde{A}}(o,q)\}]$$

$$= i\{\mu_{\tilde{A}}^{*}(mx,q),\mu_{\tilde{A}}^{*}(my,q)\}$$

So $\mu_{\tilde{A}}^{*}$ is a normal Q fuzzy subgroup of R

4 : Q – FUZZY SOFT IDEALS

We shall first concentrate ourselves to fuzzy soft ideals and then Q –fuzzy soft ideals .

DEF(4.1) : Let $(R,+,\cdot)$ be a ring and E be the set of parameter such that $A \subseteq E$.

Let $F : A \to I^X$ is a mapping where I=[0,1] , I^X being the collection of all fuzzy subsets of X .

Then (F,A) is called a fuzzy soft left ideals over R iff for each $p \in A$, the corresponding

fuzzy subset $\widetilde{F}_p : R \to [0,1]$ is a fuzzy left ideal of R . i.e

(i) $\widetilde{F}_p(x-y) \geq i\{\widetilde{F}_p(x), \widetilde{F}_p(y)\}$

(ii) $\widetilde{F}_p(xy) \geq \widetilde{F}_p(y) \quad \forall \quad x, y \in R$

DEF(4.2) : (F,A) is called a fuzzy soft right ideals over R iff for each $p \in A$, the corresponding

fuzzy subset $\widetilde{F}_p : R \to [0,1]$ is a fuzzy right ideal of R . i.e

(i) $\widetilde{F}_p(x-y) \geq i\{\widetilde{F}_p(x), \widetilde{F}_p(y)\}$

(ii) $\widetilde{F}_p(xy) \geq \widetilde{F}_p(x) \quad ; \quad \forall \quad x, y \in R$

DEF(4.3) : (F,A) is called a fuzzy soft ideals over R iff for each $p \in A$, the corresponding fuzzy

subset $\widetilde{F}_p : R \to [0,1]$ is a fuzzy ideal of R . i.e

(i) $\widetilde{F}_p(x-y) \geq i\{\widetilde{F}_p(x), \widetilde{F}_p(y)\}$

(ii) $\widetilde{F}_p(xy) \geq \vee\{\widetilde{F}_p(x), \widetilde{F}_p(y)\} \quad ; \quad \forall \quad x, y \in R$

DEF(4.4) : Let R be a fuzzy soft ring .Then the fuzzy subset $\widetilde{F}_p : R \to [0,1]$ is called a Q –fuzzy soft ideal in R, if

(IQ_1) $\widetilde{F}_p(x-y,q) \geq i\{\widetilde{F}_p(x,q), \widetilde{F}_p(y,q)\}$

(IQ_2) $\widetilde{F}_p(xy,q) \geq \vee\{\widetilde{F}_p(x,q), \widetilde{F}_p(y,q)\}$

$\forall \quad x, y \in R \quad ; \quad q \in Q$

THEOREM(4.5) : Let (R , +, .) be a fuzzy soft ring and E be the parameter such that $A \subseteq E$.

for each $p \in A$, the corresponding fuzzy subset $\widetilde{F}_p : R \to [0,1]$ is a Q-fuzzy soft ideal of R iff the following conditions hold

(i) $\widetilde{F}_p(x-y,q) \geq i\{\widetilde{F}_p(x,q), \widetilde{F}_p(y,q)\}$

(ii) $u(I_R, \widetilde{F}_p) \leq \widetilde{F}_p$ and $u(\widetilde{F}_p, I_R) \leq \widetilde{F}_p$ respectively .

I_R being characteristic function of R and u being the fuzzy t co-norm .

Proof : Suppose that $\widetilde{F}_p : R \to [0,1]$ be a Q- fuzzy soft left ideal over R for each $p \in A$.

$\Rightarrow$ 1. $\tilde{F}_p(x-y,q) \geq i\{\tilde{F}_p(x,q), \tilde{F}_p(y,q)\}$

2. $\tilde{F}_p(xy,q) \geq \tilde{F}_p(y,q)$, $\forall$ $x, y \in R$; $q \in Q$

Let z be the element of R . Then by definition (2.8)

$$u(I_R, \tilde{F}_p)z = \vee_{z=(xy,q)} [\wedge\{I_R(x), \tilde{F}_p(y,q)\}]$$

$$\vee_{z=(xy,q)} [\tilde{F}_p(y,q)]$$

$$\leq \tilde{F}_p(xy,q) \quad \text{by condition (2)}$$

$$= \tilde{F}_p(z)$$

If z be not expressed as $z = (xy,q)$,where $x, y \in R$ and $q \in Q$, then

$$u(I_R, \tilde{F}_p)z = 0 \leq \tilde{F}_p(z)$$

$$\therefore \ u(I_R, \tilde{F}_p) \leq \tilde{F}_p$$

Similarly , we can prove that

$$u(\tilde{F}_p, I_R) \leq \tilde{F}_p$$

Also (i) follows by (ii)

Conversely , suppose that (i) and (ii) hold for any fuzzy subset (F,A) over R with $p \in A$

Then $\tilde{F}_p(x-y,q) \geq i\{\tilde{F}_p(x,q), \tilde{F}_p(y,q)\}$

$$u(I_R, \tilde{F}_p) \leq \tilde{F}_p$$

Clearly then , $\tilde{F}_p(xy,q) \geq u\{I_R, \tilde{F}_p\}(xy,q) \geq \tilde{F}_p(y,q)$

$\Rightarrow$ $\tilde{F}_p$ is a Q-fuzzy soft left ideal in R .

Similar proof for Q-fuzzy soft right ideal in R can be established .

This means .

$(IQ)_1$ $\tilde{F}_p(x-y,q) \geq i\{\tilde{F}_p(x,q), \tilde{F}_p(y,q)\}$

$(IQ)_2$ $\tilde{F}_p(xy,q) \geq \vee\{\tilde{F}_p(x,q), \tilde{F}_p(y,q)\}$

$\forall$ $x, y \in R$; $q \in Q$

$\Rightarrow$ $\tilde{F}_p$ is a Q-fuzzy soft ideal in R .

5. CONCLUSION

In the present paper , the theoretical point of view of Q-fuzzy soft ring and Q-fuzzy soft ideal are discussed .These concept are basic supporting structure for development of soft set theory . one can extend this work by studying other algebraicstructures

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