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Research Article

Q-INTUITIONISTIC FUZZY ORDERED QUASI-FILTER TENNARY Γ SEMIRING

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ABSTRACT

In this paper the notion of structures of Q-intuitionistic fuzzy ordered quasi filter in ordered Γ-ternary semiring some definitions and theorems related with intuitionistic fuzzy ordered quasi filters are also discussed.

INTRODUCTION

M.Murali krishna rao introduced the notion of Γ-semiring which is a generalization of ring, tennary semiring & semiring. Kim&park studies fuzzy ideals in semirings. W.G. Lister also studied in algebraic system of a terror ring. In kar studied quasi-ideals bi-ideals of tennary semirings. Murali Krishna Rao introduced the fuzzy filter in Γ-semrings. In this paper we introduce the notion Q- intuitionistic fuzzy ordered quasi filters in tanary Γ-semirings and study some of their properties.

Definition

A non-empty set S together with a binary operation called addition and a ternary multiplication denoted by just a position is said to be a ternary semiring if S is additive commutative semigroup satisfying the following conditions.

1. (abc)de= a(bcd)e= ab(cde)
2. (a+b)cd = acd+bcd
3. a(b+c)d= abd+acd
4. ab(c+d) = abc + ade for all a,b,c,d,e, ∈ S
5. and we know about the intuitionistic fuzzy ordered filters and Q- intuitionistic fuzzy tennary sub semiring

Definition

Let F=(μ_F, ν_F) be a Q-intuitionistic fuzzy ordered subset of a tennary Γ semiring R ,we define

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$$\mu(x)=\begin{cases}\sup\{\min\{\mu_F(a,q),\mu_F(b,q)\}\}, & \text{if } w=u\alpha(a+u\beta b\gamma v)\eta z, a,b,u,v\in R \text{ and } \alpha,\beta,\gamma,\eta\in\Gamma, q\in Q\\ 0 & \text{otherwise}\end{cases}$$

$$\nu(x)=\begin{cases}\inf\{\max\{\nu_F(a,q),\nu_F(b,q)\}\}, & \text{if } w=u\alpha(a+u\beta b\gamma v)\eta z, a,b,u,v\in R \text{ and } \alpha,\beta,\gamma,\eta\in\Gamma, q\in Q\\ 1 & \text{otherwise}\end{cases}$$

Definition

A Q-intuitionistic fuzzy ordered subsemiring $F=(\mu_F, \nu_F)$ of a ternary Γ-semiring R is called a Q-intuitionistic fuzzy orderd quasi-filter of R if

$\mu_F(x,q) \le \max\{\mu_{F\Gamma R\Gamma R}(x,q), \mu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}(x,q), \mu_{R\Gamma R\Gamma F}(x,q)\}$ and $\nu_F(x,q) \ge \min\{\nu_{F\Gamma R\Gamma R}(x,q), \nu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}(x,q), \nu_{R\Gamma R\Gamma F}(x,q)\}$ for all x∊R,q ∊Q

Definition

Let $F=(\mu_F, \nu_F)$ be a Q-intuitionistic fuzzy ordered subset of a tennary Γ-semiring R. Then the set $F_\alpha=\{x,y, \in R/A(x\gamma y,q)\ge A(x,q)\ge \alpha, q \in Q, t\in[0,1]\}$ is called level subset of R with respect to F .

Theorems

Theorem

Let $F=(\mu_F, \nu_F)$ be a Q-intuitionistic fuzzy ordered subset of R. If F is a Q-intuitionistic fuzzy orderd filter of R then F is a Q-intuitionistic fuzzy orderd quasi-filter of R.

Proof

Let F be a Q-intuitionistic fuzzy orderd filter of R.
Let $x=a\alpha r_1\gamma r_2=r_1\beta(b_1+r_1\gamma b_2\delta r_2)\eta r_2==r_1\beta r_2\gamma d$, $a,b_1,b_2,c,r_1,r_2 \in R$,α, β , γ , η∈ Γ. Consider,
$\max\{\mu_{F\Gamma R\Gamma R}(x,q), \mu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}(x,q), \mu_{R\Gamma R\Gamma F}(x,q)\}$
$=\max\{\mathrm{Sup}_{x=a\alpha r1\gamma r2}\{\mu_F(a,q)\},\mathrm{Sup}_{x=a\alpha r1\gamma r2+r1\beta(b1+r1\gamma b2\delta r2)\eta r2}\{\mu_F(b,q),\mu_F(c,q)\},\mathrm{Sup}_{x=r1\beta r2\gamma cd}\{\mu_F(d,q)\}$
$\ge\{0, \mathrm{Sup}_{x=r1\beta(b1+r1\gamma b2\delta r2)\eta r2}\min\{\mu_F(r_1\beta(b_1+r_1\gamma b_2\delta r_2)\eta r_2,q)\},0\}$
Since F is a Q-intuitionistic fuzzy orderd filter of R.
$\mu_F(r_1\beta(b_1+r_1\gamma b_2\delta r_2)\eta r_2,q)\le\max\{\mu_F(b,q),\mu_F(c,q)\}$.Hence
$\max\{\mu_{F\Gamma R\Gamma R}(x,q), \mu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}(x,q), \mu_{R\Gamma R\Gamma F}(x,q)\}\ge\mu_F(x,q)$
$\min\{\nu_{F\Gamma R\Gamma R}(x,q), \nu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}(x,q), \nu_{R\Gamma R\Gamma F}(x,q)\}$
$=\min\{\mathrm{Sup}_{x=a\alpha r1\gamma r2}\{\nu_F(a,q)\},\mathrm{Sup}_{x=a\alpha r1\gamma r2+r1\beta(b1+r1\gamma b2\delta r2)\eta r2}\{\nu_F(b,q),\nu_F(c,q)\},\mathrm{Sup}_{x=r1\beta r2\gamma cd}\{\nu_F(d,q)\}$
$\le\{1, \mathrm{Sup}_{x=r1\beta(b1+r1\gamma b2\delta r2)\eta r2}\min\{\nu_F(r_1\beta(b_1+r_1\gamma b_2\delta r_2)\eta r_2,q)\},1\}$
Since F is a Q-intuitionistic fuzzy orderd filter of R.
$\nu_F(r_1\beta(b_1+r_1\gamma b_2\delta r_2)\eta r_2,q)\ge\min\{\nu_F(b,q),\nu_F(c,q)\}$.Hence
$\min\{\nu_{F\Gamma R\Gamma R}(x,q), \nu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}(x,q), \nu_{R\Gamma R\Gamma F}(x,q)\}\le\nu_F(x,q)$.

Lemma

For any non-empty subsets A,B,C of R (i) $\chi_A\Gamma\chi_B\Gamma\chi_C=\chi_{A\Gamma B\Gamma C}$
(ii) $\chi_A\cap\chi_B\cap\chi_C=\chi_{A\cap B\cap C}$ (iii) $\chi_A+\chi_B=\chi_{A+B}$

Theorem

Let $F=(\mu_F, \nu_F)$ be an additive subsemigroup of R. If F is a orderd quasi filter of R iff $\chi_F=(\mu_{\chi_A}, \nu_{\chi_A})$ is a Q-intuitionistic fuzzy orderd quasi-filter of R.

Proof

Assume that F is a orderd quasi filter of R.Let $\chi_F=(\mu_{\chi_A}, \nu_{\chi_A})$ is a Q-intuitionistic fuzzy orderd subsemigroup of R.

$\max\{\mu_{\chi_{F\Gamma R\Gamma R}}(x,q), \mu_{\chi_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}}(x,q), \mu_{\chi_{R\Gamma R\Gamma F}}(x,q)\}$

$=\max\{\mu_{\chi_F\Gamma\chi_R\Gamma\chi_F}(x,q), \mu_{\chi_{R}\Gamma\chi_F\Gamma\chi_R+\chi_R\Gamma\chi_R\Gamma\chi_F\Gamma\chi_R\Gamma\chi_R}(x,q), \mu_{\chi_R\Gamma\chi_R\Gamma\chi_F}(x,q)\}$

$=\max\{\mu_{\chi_{F\Gamma R\Gamma R}}(x,q), \mu_{\chi_{R\Gamma R\Gamma F\Gamma R\Gamma R}}(x,q), \mu_{\chi_{R\Gamma R\Gamma F}}(x,q)\}$

$= \mu_{\chi_{\max\{F\Gamma R\Gamma R,.R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R\Gamma R\Gamma F,R\Gamma R\Gamma F\}}}$ (x,q)

$\geq \mu_{\chi_F}$ (x,q)

min{ $\nu_{\chi_{F\Gamma R\Gamma R}}$ (x,q) , $\nu_{\chi_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}}$ (x,q) , $\nu_{\chi_{R\Gamma R\Gamma F}}$ (x,q)}

=min{ $\nu_{\chi_F \Gamma\chi_R\Gamma\chi_F}$ (x,q) , $\nu_{\chi_{R}\Gamma\chi_F\Gamma\chi_{R+}\chi_R\Gamma\chi_R\Gamma\chi_F\Gamma\chi_R\Gamma\chi_R}$ (x,q) , $\nu_{\chi_R\Gamma\chi_R\Gamma\chi_F}$ (x,q)}

= min{ $\nu_{\chi_{F\Gamma R\Gamma R}}$ (x,q) , $\nu_{\chi_{R\Gamma R\Gamma F\Gamma R\Gamma R}}$ (x,q) , $\nu_{\chi_{R\Gamma R\Gamma F}}$ (x,q)}

$= \nu_{\chi_{\max\{F\Gamma R\Gamma R,.R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R\Gamma R\Gamma F,R\Gamma R\Gamma F\}}}$ (x,q)

$\leq \nu_{\chi_F}$ (x,q)

Hence χ_F =(μ_{χ_A} , ν_{χ_A}) is a Q-intuitionistic fuzzy orderd quasi-filter of R.

Conversly Let y∈F ,Then μ_{χ_F} (y,q)=1 , ν_{χ_F} (y,q) = 0

Also, 1 = μ_{χ_F} (y,q) $\leq$ max{ $\mu_{\chi_{F\Gamma R\Gamma R}}$ (y,q) , $\mu_{\chi_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}}$ (y,q) , $\mu_{\chi_{R\Gamma R\Gamma F}}$ (y,q)}

=max{ $\mu_{\chi_F \Gamma\chi_R\Gamma\chi_F}$ (y,q) , $\mu_{\chi_{R}\Gamma\chi_F\Gamma\chi_{R+}\chi_R\Gamma\chi_R\Gamma\chi_F\Gamma\chi_R\Gamma\chi_R}$ (y,q) , $\mu_{\chi_R\Gamma\chi_R\Gamma\chi_F}$ (y,q)}

= max{ $\mu_{\chi_{F\Gamma R\Gamma R}}$ (y,q) , $\mu_{\chi_{R\Gamma R\Gamma F\Gamma R\Gamma R}}$ (y,q) , $\mu_{\chi_{R\Gamma R\Gamma F}}$ (y,q)}

$= \mu_{\chi_{\max\{F\Gamma R\Gamma R,.R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R\Gamma R\Gamma F,R\Gamma R\Gamma F\}}}$ (y,q) ,

Now ,0 = ν_{χ_F} (y,q) ≥ min{ $\nu_{\chi_{F\Gamma R\Gamma R}}$ (y,q) , $\nu_{\chi_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}}$ (y,q) , $\nu_{\chi_{R\Gamma R\Gamma F}}$ (y,q)}

=min{ $\nu_{\chi_F \Gamma\chi_R\Gamma\chi_F}$ (y,q) , $\nu_{\chi_{R}\Gamma\chi_F\Gamma\chi_{R+}\chi_R\Gamma\chi_R\Gamma\chi_F\Gamma\chi_R\Gamma\chi_R}$ (y,q) , $\nu_{\chi_R\Gamma\chi_R\Gamma\chi_F}$ (y,q)}

= min{ $\nu_{\chi_{F\Gamma R\Gamma R}}$ (y,q) , $\nu_{\chi_{R\Gamma R\Gamma F\Gamma R\Gamma R}}$ (y,q) , $\nu_{\chi_{R\Gamma R\Gamma F}}$ (y,q)}

$= \nu_{\chi_{\max\{F\Gamma R\Gamma R,.R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R\Gamma R\Gamma F,R\Gamma R\Gamma F\}}}$ (y,q) =0.

Hence y∈max {F Γ R Γ R , R Γ F Γ R+R Γ R Γ F Γ R Γ R , R Γ R Γ F}

F ⊆ max {F Γ R Γ R , R Γ F Γ R+R Γ R Γ F Γ R Γ R , R Γ R Γ F}

Hence F is a quasi-filter of R.

Theorem

Let F= (μ_F, ν_F) be a Q-intuitionistic fuzzy ordered subset of R. If F is a Q-intuitionistic fuzzy orderd quasi-filter of R iff F_α is an quasi- filter of R, for all α∈Im(F).

Proof

Let F be a Q-intuitionstic fuzzy ordered quasi-filter of R. Let α∈Im(F). Suppose x,y∈R such that x,y∈ F_α. Then μ_{F_α} (x,q)≥ α and ν_{F_α} (y,q) ≥ α and max { μ_{F_α} (x,q), μ_{F_α} (y,q)} ≥ α and min{ ν_{F_α} (x,q), ν_{F_α} (y,q)}≤ α. Since F is a Q-intuitionistic fuzzy ordered quasi-filter, μ_{F_α} (x+y,q) ≥ α and ν_{F_α} (x+y,q) ≤ α Hence x+y ∈ F_α .Suppose x ∈F_α . Then μ_{F_α} (x,q)≥ α and ν_{F_α} (x,q) ≤ α

Since F is a Q-intuitionistic fuzzy ordered quasi-filter, max{ $\mu_{F\Gamma R\Gamma R}$ (x,q) , $\mu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}$ (x,q) , $\mu_{R\Gamma R\Gamma F}$ (x,q)} ≥α and min{ $\nu_{F\Gamma R\Gamma R}$ (x,q) , $\nu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}$ (x,q) , $\nu_{R\Gamma R\Gamma F}$ (x,q)}≤ α . We know $\mu_{F\Gamma R\Gamma R}$ (y,q) = sup {μ_F(x,q)}. y=α$\beta r_1\gamma r_2$

$\mu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}$ (y,q) = sup min{$\mu_F(b_1,q)$,$\mu_F(b_2,q)$}. y=$r_1\beta(b_1$+r1$\gamma b_2 r_2)\beta r_2$

$\mu_{R\Gamma R\Gamma F}$ (y,q) = sup {μ_F (c,q)}. y=$r_1\beta r_2$ γ C

Therefore max{μ_F(a,q) min{$\mu_F(b_1,q)$,μ_F (b_2,q)}, μ_F (c,q)}≥ α .Thus one of these three values ≥ α.

$\nu_{F\Gamma R\Gamma R}$ (y,q) = inf {ν_F(x,q)} y=α$\beta r_1\gamma r_2$

$\nu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}$ (y,q) = inf min{$\nu_F(b_1,q)$, $\nu_F(b_2,q)$}.

y=$r_1\beta(b_1$+r1$\gamma b_2 r_2)\beta r_2$

$\nu_{R\Gamma R\Gamma F}$ (y,q) = inf {ν_F (c,q)}.

y=$r_1\beta r_2$ γ C

Therefore min {ν_F(a,q) max{ ν_F (b_1,q) , ν_F (b_2,q)}, ν_F (c,q)} ≤ α such that y=α$\beta r_1\gamma r_2$=$r_1\beta((b_1+r_1\gamma r_2)\eta r_2$==$r_1\beta r_2\gamma$c

Thus one of these three values ≤ α.Hence one of these values a,b_1,b_2 and c∈Fα
Therefore y∈max{Fα Γ R Γ R Γ,R Γ Fα Γ R+R Γ R Γ Fα Γ R Γ R, R Γ R Γ Fα}
Hence F_α is a quasi-filter of R.

Conversly let us assume that F_α is an quasi-flter of R, α∈Im(F). Let μ∈R

Consider max{($\mu_{F\Gamma R\Gamma R}$)(u,q),($\mu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}$)(u,q),($\mu_{R\Gamma R\Gamma F}$)(u,q)}

= max{sup {μ_F(a,q)}, sup min{μ_F(b_1,q)μ_F(b_2,q)}, sup {μ_F(c,q)}}
u=αβr_1γr_2 u=r_1β(b_1+r_1γb2r_2)βr_2 u=r_1βr_2γc
Let sup μ_F(a,q) = α_1 and sup min{μ_F(b_1,q) μ_F(b_2,q)} = Sup min {α_2,α_3}=$\alpha_2$orα_3
u=αβr_1γr_2 u=r_1β(b_1+r_1γb_2 r_2)βr_2
(if α_2<α_3 or α_3<α_2)
Also sup { μ_F (c,q)=α_4
u=r1βr2γc

For any a,b_1,b_2,c,r_1,r_2 ∈R , β , γ ,η∈ Γ,q∈Q. Let α_2<α_3 . Assume that max{α_1,α_3,α_4}=α_1.Then a∈Fα_1.That is μ_F(a,q)=α_1 and Since Fα_1 is a quasi-filter of R , u=aβr_1γr_2∈ F Γ R Γ R.
So $\mu_{(F\Gamma R\Gamma R)}$(u,q)=$\alpha_1$. ν_F(a,q)
Consider min{($\nu_{F\Gamma R\Gamma R}$)(u,q),($\nu_{R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R}$)(u,q),($\nu_{R\Gamma R\Gamma F}$)(u,q)}
= min{ inf {ν_F(a,q)}, inf max{ν_F(b_1,q)μ_F(b_2,q)}, inf {ν_F(c,q)}}
u=αβr_1γr_2 u=r_1β(b_1+r_1γb2r_2)βr_2 u=r_1βr_2γc
Let inf ν_F(a,q) = α_1 and inf max{ν_F(b_1,q) ν_F(b_2,q)} = inf max {α_2,α_3}=$\alpha_2$orα_3
u=αβr_1γr_2 u=r_1β(b_1+r_1γb_2 ηr_2)βr_2
(if α_2<α_3 or α_3<α_2)
Also inf { ν_F (c,q)=α_4
u=r1βr2γc

For any a,b_1,b_2,c,r_1,r_2 ∈R , β , γ ,η∈ Γ,q∈Q. Let α_2<α_3. Assume that min{α_1,α_3,α_4}=α_1.
Then a∈Fα_1.That is ν_F(a,q)=α_1 and Since Fα_1 is a quasi-filter of R, u=aβr_1γr_2∈ F Γ R Γ R. So $\nu_{(F\Gamma R\Gamma R)}$(u,q)=$\alpha_1$.
Now max{$\mu_{(F\Gamma R\Gamma R)}$(u,q), $\mu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}$(u,q), $\mu_{(R\Gamma R\Gamma F)}$(u,q)}≥$\alpha_1$=$\mu_F$(u,q)
Let α_2>α_3 and assume that max(α_1,α_2,α_4}=α_2.Then b_1∈$\mu_{F\alpha 2}$
That is μ_F(b_1,q)=α_2.Since $\mu_{F\alpha 2}$ is a quasi-filterof R.
Then u∈{($\mu_{F\alpha 2\Gamma R\Gamma R}$)U$\mu_{(R\Gamma F\alpha 2\Gamma R+R\Gamma R\Gamma F\alpha 2\Gamma R\Gamma R)}U\mu_{(R\Gamma R\Gamma F\alpha 2)}$}
Now max{$\mu_{(F\Gamma R\Gamma R)}$ (u,q), $\mu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}$(u,q), $\mu_{(R\Gamma R\Gamma F)}$(u,q)} ≥ α_2 = μ_F(u,q)
Hence max{$\mu_{F\Gamma R\Gamma R}$, $\mu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}$, $\mu_{(R\Gamma R\Gamma F)}$}(u,q) ≥$\mu_F$(u,q).
Now min{$\nu_{(F\Gamma R\Gamma R)}$(u,q), $\nu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}$(u,q), $\nu_{(R\Gamma R\Gamma F)}$(u,q)}≤$\alpha_1$=$\nu_F$(u,q)

Let α_2>α_3 and assume that min(α_1,α_2,α_4}=α_2.Then b_1∈$\nu_{F\alpha 2}$
That is ν_F(b_1,q)=α_2.Since $\nu_{F\alpha 2}$ is a quasi-filter of R.
Then u∈{($\nu_{F\alpha 2\Gamma R\Gamma R}$)U$\nu_{(R\Gamma F\alpha 2\Gamma R+R\Gamma R\Gamma F\alpha 2\Gamma R\Gamma R)}U\nu_{(R\Gamma R\Gamma F\alpha 2)}$}
Now min{$\nu_{(F\Gamma R\Gamma R)}$ (u,q), $\nu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}$(u,q), $\nu_{(R\Gamma R\Gamma F)}$(u,q)} ≤ α_2 = νμ_F(u,q)
Hence min{$\nu_{F\Gamma R\Gamma R}$, $\nu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}$, $\nu_{(R\Gamma R\Gamma F)}$}(u,q) ≤ ν_F(u,q).
Suppose max{α_1,α_3,α_4}=α_3 or α_4.

The proof is similar.

Hence ($\mu_{(F\Gamma R\Gamma R\Gamma)}U\mu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}U\mu_{(R\Gamma R\Gamma F)}$) (u,q) ≥ μ_F(u,q) and
($\nu_{(F\Gamma R\Gamma R\Gamma)}$U $\nu_{(R\Gamma F\Gamma R+R\Gamma R\Gamma F\Gamma R\Gamma R)}$U $\nu_{(R\Gamma R\Gamma F)}$) (u,q) ≤ ν_F(u,q), for all u∈R.
Hence F is a Q-intuitionistic fuzzy ordered quasi-filter of R.

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