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ISSN: 0193-4120 Page No. 6740 - 6745

On Vague Ordered Gamma-Near Rings

K. Balakoteswara Rao [1], D. Bharathi [2], S. Ragamayi[3]
{1,2} Department of Mathematics, S V University, Tirupathi, Andhra Pradesh, India.
{3} Department of Mathematics, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India.
[1] balakoteswararaokedari@gmail.com, [2]bharathikavali@gmail.com, [3] sistla.raaga1230@gmail.com

Article Info
Volume 83
Page Number: 6740 - 6745
Publication Issue:
March - April 2020

Abstract:

Abstract: In this paper, we originate and inspect the notion of vague Ordered $\Gamma-$ Near rings and it's properties.We establish one-one correspondence between Vague Ordered Γ-Near ring and crisp Ordered Γ-Near ring. Also, we provide the necessary and sufficient condition for a vague set to be a vague ordered Γ-Near ring.

Keywords: Vague set, Vague Ordered $\Gamma-$ Near ring

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Article History
***Article Received**: 24 July 2019*
***Revised**: 12 September 2019*
***Accepted**: 15 February 2020*
***Publication**: 05 April 2020*

I. INTRODUCTION

The hypothesis of fuzzy Near rings has been created by Bh. Satyanarayana [1] and G.L. Booth. Afterward W.L.Gau and D.J. Buehrer [18] presented the hypothesis of vague sets as an improvement of the hypothesis of fuzzy sets in resembling the valid condition. Vague sets are higher classification of fuzzy sets. As per them a vague set A in the universe of discourse U is a pair (t_A, f_A), where t_A *and* f_A are fuzzy subsets of U fulfilling $t_A(u) + f_A(u) \leq 1, \forall u \in U$.

Further K. Balakoteswara rao [2] had introduced and studied the concepts of L – Fuzzy sub Ordered $\Gamma-$Near ring. As a overview of it, we introduce the algebraic structure "vague Ordered $\Gamma-$ Near rings(VOGNR)". We establish one-one correspondence between VOGNR and crisp OGNR. We confirm that the intersection of two VOGNRs is also VOGNR. .

II. PRELIMINARIES

Definition 2.1 : A zero – symmetric GNR is a trip[le $(\widetilde{K},+,\Gamma)$, where

1. $(\widetilde{K},+)$ is a group
2. $(\widetilde{K},+,\delta)$ is a nearring where Γ≠Φ with binary operators on $\widetilde{K}$, $\forall\ \delta \in \Gamma$.
3. $f\ \delta(g\ \eta\ h) = (f\ \delta g)\eta h \quad \forall f, g, h \epsilon \widetilde{K}; \delta, \eta\ \epsilon\ \Gamma$.
4. $f\ \delta\ g = 0, \forall f\ \in \widetilde{K}, \delta \in \Gamma$.

Definition 2.2 : E ≠Φ, A⊆$\widetilde{K}$, where $\widetilde{K}$ be a GNR is said to be a SGNR if

1. $f - g\ \in E$
2. $f\ \delta\ g \in E, \forall \delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$

Definition 2.3: A Fuzzy subset W of $\widetilde{K}$ is a Fuzzy SGNR , if

1. $W(f-g) \geq \{\ W(f), W(g)\}$
2. $W(f\ \delta\ g) \geq \{\ W(f), W(g)\}, \forall \delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$

Definition 2.4 : The vague value of w in $N = (t_N, f_N)$ is defined as $V_N(w)$= $[t_N(w), 1 - f_N(w)]$.

Definition 2.5 : The union of two vague sets N and M is defined as

$$t_C = max\ \{t_N, t_M\};$$
$$1 - f_C = \{1 - f_N, 1 - f_M\}.$$

Definition 2.6 : The intersection of two vague sets N and M is defined as

$$t_C = min\ \{t_N, t_M\};\ 1 - f_C = \{1 - f_N, 1 - f_M\}.$$

Definition 2.7 : The vague-cut of a vague set N is the crisp subset of U is given by

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$$N_{(\beta,\gamma)} = \{f \in U\,; V_N \geq [\beta,\gamma]\}.$$

Definition 2.8 : A vague set $N = (t_N, f_N)$ of $\widetilde{K}$ is called as a VGNR if

1. $V_N(f-g) \geq \{\ V_N(f), V_N(g)\}$
2. $V_N(f\ \delta\ g) \geq \{\ V_N(f), V_N(g);$ $\forall \delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$

Definition 2.9 : A GNR, $\widetilde{K}$ is called as an OGNR if it admits a compatible relation "$\leq$", If $a \leq b$ and $c \leq d$ then

1. $a + c\ \leq b + d$
2. $a\delta c\ \leq b\delta d$
3. $c\delta a \leq d\delta b; \forall\ a, b, c, d\ \epsilon\ \widetilde{K}; \delta \in \Gamma.$

Definition 2.10 : Let $\widetilde{K}$ be a partially OGNR . $\emptyset \neq N\ of \widetilde{K}$ is said to be SOGNR,if

1. $f - g \in\ N$
2. $f\delta g\ \in\ N$
3. $if\ a\ \leq b\ then\ a + f \leq b + g$
4. $if\ a\ \leq b\ and\ c\ \geq 0\ then\ c\ \delta a \leq c\delta b\ and\ a\delta c \leq b\delta c;$ $\forall\ a, b, c, f, g\ \epsilon\ \widetilde{K}; \delta \in \Gamma.$

Definition 2.11 : Let $\widetilde{K}$ be an OGNR .A fuzzy subset W of $\widetilde{K}$ is said to FSOGNR Of $\widetilde{K}$ if

1. $W(f-g) \geq \{\ W(f), W(g)\}$
2. $W(f\ \delta\ g) \geq \{\ W(f), W(g)\},$
3. $f \leq g \Longrightarrow W(f) \geq W(g);\ \forall \delta \in \Gamma;$ $f, g\ \epsilon\ \widetilde{K}.$

Notations :

1. $\widetilde{K}$ stands for Zero – Symmetric Ordered $\Gamma-$ Near ring.
2. OGNR stands for Ordered $\Gamma-$ Near ring.
3. GNR stands for $\Gamma-$ Near ring.
4. SGNR stands for Sub $\Gamma-$ Near ring.
5. VGNR stands for Vague $\Gamma-$ Near ring.
6. FSOGNR stands for Fuzzy Sub Ordered $\Gamma-$ Near ring.
7. VOGNR stands for Vague Ordered $\Gamma-$ Near ring.
8. FOGNR stands for Fuzzy Ordered $\Gamma-$ Near ring.

III. MAIN RESULTS

Definition 3.1 : A vague set $N = (t_N, f_N)$ of $\widetilde{K}$ is said to be VOGNR if

1. $V_N(f-g) \geq \{\ V_N(f), V_N(g)\}$
2. $V_N(f\ \delta\ g) \geq \{\ V_N(f), V_N(g)\}$
3. $f \leq g \Longrightarrow V_N(f) \geq V_N(g);\ \forall \delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$

i.e.,

1. $t_N(f-g) \geq \{\ t_N(f), t_N(g)\}$
2. $t_N(f\ \delta\ g) \geq \{\ t_N(f), t_N(g)\}$
3. $f \leq g \Longrightarrow t_N(f) \geq t_N(g);\ \forall \delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$ and

1. $1 - f_N(f-g) \geq \{\ 1 - f_N(f), 1 - f_N(g)\}$
2. $1 - f_N(f\ \delta\ g) \geq \{\ 1 - f_N(f), 1 - f_N(g)\}$
3. $f \leq g \Longrightarrow 1 - f_N(f) \geq 1 - f_N(g);$

$\forall \delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$

Example 3.2 : Let $\widetilde{K} = \Gamma =$ "z" (the set of integers) which is clearly a GNR. Also, "z" admits a compatible relation "$\leq$" which is a partial ordering on $\widetilde{K}$.
Hence $\widetilde{K}$ is an OGNR . Let $N = (t_N, f_N)$, where $t_N : \widetilde{K} \to [0,1]$, $f_N : \widetilde{K} \to [0,1]$
Defined by

$t_N(f) = \{0.3, \quad if\ f = 0\ 0.4, if\ f\ is\ positive\ 0.6, if\ f\ is\ negative$
$t_N(f) = \{0.7, \quad if\ f = 0\ 0.5, if\ f\ is\ positive\ 0.4, if\ f\ is\ negative$

Then N is a VOGNR of $\widetilde{K}$.

Theorem 3.3 : A necessary and sufficient condition for a vague set $N = (t_N, f_N)$, of $\widetilde{K}$ to be a VOGNR of $\widetilde{K}$ is that $t_N\ and 1 - f_N$ are FOGNRs of $\widetilde{K}$.
Proof : Suppose $N = (t_N, f_N)$, is a VOGNR of M.

$Let\ \forall \delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$.Then
$V_N(f-g) \geq \{\ V_N(f), V_N(g)\}$

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$V_N(f\ \delta\ g) \geq \{\ V_N(f), V_N(g)\}$
$f \leq g \Longrightarrow V_N(f) \geq V_N(g);\ \forall\delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$
i.e.,
$t_N(f-g) \geq \{\ t_N(f), t_N(g)\}$
$t_N(f\ \delta\ g) \geq \{\ t_N(f), t_N(g)\}$
$f \leq g \Longrightarrow t_N(f) \geq t_N(g);\ \forall\delta \in \Gamma; f, g\ \epsilon\ \widetilde{K}$
and

$1 - f_N(f-g) \geq \{\ 1 - f_N(f), 1 - f_N(g)\}$
$1 - f_N(f\ \delta\ g) \geq \{\ 1 - f_N(f), 1 - f_N(g)\}$
$f \leq g \Longrightarrow 1 - f_N(f) \geq 1 - f_N(g);$

Hence t_N and $1 - f_N$ are FOGNR of M. The converse part is clear from the definition.

Theorem 3.4 : A vague set $N = (t_N, f_N)$ of M is a VOGNR of M if and only if for any $\beta, \gamma \in [0,1]$ the vague cut $N_{(\beta,\gamma)}$ is a SOGNR of M.
Proof: Suppose N is a VOGNR of $\widetilde{K}$.
Let f,g $\epsilon N_{(\beta,\gamma)}$ and $\delta \in \Gamma$.
$V_N(f) \geq [\beta,\gamma]$ and $V_N(g) \geq [\beta,\gamma]$
We have
$V_N(f-g) \geq \{\ V_N(f), V_N(g)\} \geq [\beta,\gamma]$
$\Rightarrow\ f - g \in N_{(\beta,\gamma)}$
$V_N(f\delta g) \geq \{\ V_N(f), V_N(g)\} \geq [\beta,\gamma]$
$\Rightarrow\ f\delta g \in N_{(\beta,\gamma)}$
Clearly $N_{(\beta,\gamma)}$ admits partial ordering.
Hence $N_{(\beta,\gamma)}$ *is* SOGNR of $\widetilde{K}$.
Conversely suppose $N_{(\beta,\gamma)}$ *is* SOGNR of $\widetilde{K}$.
$[\beta,\gamma]$=min$\{[\beta_1,\gamma_1], [\beta_2,\gamma_2]\}$

Then f,g $\epsilon N_{(\beta,\gamma)} \Rightarrow f - g \in N_{(\beta,\gamma)}$
And $f\ \delta\ g \in N_{(\beta,\gamma)}$
Which implies $V_N(f-g) \geq \{\ V_N(f), V_N(g)\}$
And $V_N(f\delta g) \geq \{\ V_N(f), V_N(g)\}$

Let $f \leq g$, suppose if possible $V_N(f) < V_N(g)$
$[\beta_1,\gamma_1] \in [0,1]$
$V_N(f) < [\beta_1,\gamma_1] < V_N(g)$
g$\epsilon N_{([\beta_1,\gamma_1})}$ and f$\notin N_{([\beta_1,\gamma_1})}$
which is a contradiction.
Therefore $V_N(f) \geq V_N(g)$.
Hence N *is* VOGNR of $\widetilde{K}$.

Corollary 3.5 : Let N be a VOGNR of $\widetilde{K}$. Then for $\in [0,1]$, the β cut N_β is a SOGNR of $\widetilde{K}$.

Now, we introduce the vague characteristic set of $\widetilde{K}$.

Definition 3.6 : Let characteristic set χ=(t_χ, f_χ) be a vague set of $\widetilde{K}$. For any subset S of $\widetilde{K}$, the vague characteristic set of S taking values in [0,1] is defined by
$V_{\chi_s}(f) = \{[1,1] if\ f \epsilon s\ [0,0] if\ f \notin s$

Then χ_s is called the vague characteristic set of S
in [0,1].

Theorem 3.7 : Let $\emptyset \neq S \sqsubseteq \widetilde{K}$. Then the vague characteristic set V_{χ_s} of $'S'$ is VOGNR of $\widetilde{K}$ if and only if $'S'$ is SOGNR of $\widetilde{K}$.
Proof: Suppose χ_s is a VOGNR of $\widetilde{K}$.
$Let\ \forall\delta \in \Gamma; f, g\ \epsilon\ S$. Then
$V_{\chi_s}(f-g) \geq \{\ V_{\chi_s}(f), V_{\chi_s}(g)\}$ =[1,1]
$\Rightarrow\ f - g \epsilon S$
$V_{\chi_s}(f\ \delta\ g) \geq \{\ V_{\chi_s}(f), V_{\chi_s}(g)\}$ =[1,1]]
$\Rightarrow\ f\delta g \epsilon S$
Since $S \sqsubseteq \widetilde{K}$ *, it admits partial ordering*
$f \leq g \Longrightarrow V_{\chi_s}(f) \geq V_{\chi_s}(g);$
Thus $'S'$ is SOGNR of $\widetilde{K}$.
Suppose $'S'$ is SOGNR of $\widetilde{K}$.
Let f,g$\epsilon\ \widetilde{K}$ *and* $\forall\delta \in \Gamma$
If f,g$\epsilon\ S \Rightarrow\ f - g\epsilon S, f\delta g\epsilon S$ *then*
$V_{\chi_s}(f-g)$ =[1,1]= $\{\ V_{\chi_s}(f), V_{\chi_s}(g)\}$
$V_{\chi_s}(f\delta g)$ =[1,1]= $\{\ V_{\chi_s}(f), V_{\chi_s}(g)\}$
If f,g$\notin S \Rightarrow\ f - g \notin S, f\delta g \notin S$ *then*
$V_{\chi_s}(f-g)$ =[0,0]= $\{\ V_{\chi_s}(f), V_{\chi_s}(g)\}$
$V_{\chi_s}(f\delta g)$ =[0,0]= $\{\ V_{\chi_s}(f), V_{\chi_s}(g)\}$
A similar argument can be made if f $\epsilon\ S$ and g$\notin$ S.
For $f \leq g$
If f,g$\epsilon\ S$ then $V_{\chi_s}(f) = [1,1]$ and $V_{\chi_s}(g) = [1,1]$ implies $V_{\chi_s}(f) \geq V_{\chi_s}(g)$
If f,g$\notin S$ then $V_{\chi_s}(f) = [0,0]$ and $V_{\chi_s}(g) = [0,0]$ implies $V_{\chi_s}(f) \geq V_{\chi_s}(g)$
If fϵS and g$\notin S$ then $V_{\chi_s}(f) = [1,1]$ and $V_{\chi_s}(g) = [0,0]$ implies $V_{\chi_s}(f) \geq V_{\chi_s}(g)$
Thus χ_s is a VOGNR of $\widetilde{K}$.

Theorem 3.8 :
Let S be a SOGNR of $\widetilde{K}$. Then for any $0 < \beta < \gamma < 1$, $\exists$ VOGNR, N of $\widetilde{K}$;

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$\ni, N_{(\beta,\gamma)} = S$.

Proof : Let S be a SOGNR of a GNR $\widetilde{K}$.

Define a vague set $N = (t_N, f_N)$ on $\widetilde{K}$ by
$V_N(f) = \{[\beta,\gamma] if\ f \epsilon s\ [0,0] if\ f \notin s$

Clearly , $N_{(\beta,\gamma)} = N$.

If f,gϵ $\widetilde{K}$; $\forall\delta \in \Gamma \Rightarrow f - g \epsilon \widetilde{K}, f\delta g \epsilon \widetilde{K}$ $then$
$V_N(f-g)$ =[β,γ]= { $V_N(f), V_N(g)$}
$V_N(f\delta g)$ =[β,γ]= { $V_N(f), V_N(g)$}

If f,g$\notin$ $\widetilde{K}$ then
$V_N(f-g)$ =[0,0]= { $V_N(f), V_N(g)$}
$V_N(f\delta g)$ =[0,0]= { $V_N(f), V_N(g)$}

if f $\notin S$ and gϵ S then $V_N(f) =$ [0,0]$and\ V_N(g)$ =[β,γ]
$V_N(f-g) \geq$ { $V_N(f), V_N(g)$}
$V_N(f\delta g) \geq$ { $V_N(f), V_N(g)$}

A similar argument could be made for fϵS and g$\notin S$.

For $f \leq g$

If f,gϵ S then $V_N(f)$ =[β,γ] and $V_N(g)$ =[β,γ]$\Longrightarrow V_N(f) \geq V_N(g)$

If f,g$\notin$ S then $V_N(f)$ =[0,0] and $V_N(g)$ =[0,0]$\Longrightarrow V_N(f) \geq V_N(g)$

If fϵS and g$\notin$ $S\ then\ V_N(f)$ =[β,γ] and $V_N(g)$ =[0,0]$\Longrightarrow V_N(f) \geq V_N(g)$

$Hence\ , N_{(\beta,\gamma)} = S$.

Theorem 3.9 : Let $N = (t_N, f_N)$ be a $VOGNR$ of a left (resp, right) zero OGNR $\widetilde{K}$.
Then $V_N(f) = V_N(g)$, $\forall$f,gϵ $\widetilde{K}$.

Proof : Let $\widetilde{K}$ be a left zero OGNR.
Let f,gϵ $\widetilde{K}$; $\forall\delta \in \Gamma$.

Since $\widetilde{K}$ is left zero$\Rightarrow$ $f\delta g = f\ and\ g\delta f = g$.
Now,
$V_N(f\delta g) \geq$ { $V_N(f), V_N(g)$}
$\Rightarrow V_N(f) \geq$ { $V_N(f), V_N(g)$}
$\Rightarrow V_N(f) \geq V_N(g)$
Also,
$V_N(g\delta f) \geq$ { $V_N(f), V_N(g)$}
$\Rightarrow V_N(g) \geq$ { $V_N(f), V_N(g)$}
$\Rightarrow V_N(g) \geq V_N(f)$
Hence $V_N(f) = V_N(g)$.

We can deal with the other case also in a similar way.

Theorem 3.10 : Let N be a $VOGNR$ of $\widetilde{K}$. Then $K_N = \{f \in \widetilde{K}/V_N(0)\}$ is a $SOGNR$ of $\widetilde{K}$.

Proof :
Let f,gϵK_N $and\ \delta \in \Gamma$.
So, $V_N(f) = V_N(0)$ and $V_N(g) = V_N(0)$.
Now,

1. $V_N(f-g) \geq$ { $V_N(f), V_N(g)$} $= V_N(0)$
2. $V_N(f\delta g) \geq$ { $V_N(f), V_N(g)$} $= V_N(0)$

From 1 and 2,it is clear that $f - g\epsilon K_N, f\delta g\ \epsilon K_N$.
3. For every f,gϵK_N which contains an $OGNR$ $,\widetilde{K}$ implies K_N possess partial ordering. Thus is a $SOGNR$ of $,\widetilde{K}$.

Theorem 3.11 : Let $N = (t_N, f_N)$ and $M = (t_M, f_M)$, be two $VOGNR$s of $\widetilde{K}$.
Then $N \cap M$ is a $VOGNR$ of $\widetilde{K}$.

Proof: $Let\ N = (t_N, f_N)$ and $M = (t_M, f_M)$ be two $VOGNRs$ of $\widetilde{K}$. Then

$t_{N\cap M}(f-g) = \{t_N(f-g), t_M(f-g)\}$
$\geq$
$\{\{t_N(f), t_N(g)\}, \{t_M(f), t_M(g)\}\}$

=min$\{\{t_N(f), t_M(f)\}, \{t_N(g), t_M(g)\}\}$
=$\{t_{N\cap M}(f), t_{N\cap M}(g)\}$ and

$1 - f_{N\cap M}(f-g) = \{1 - f_N(f-g), 1 - f_M(f-g)\}$
$\geq \{\{1 - f_N(f), 1 - f_N(g)\}, \{1 - f_M(f), 1 - f_M(g)\}\}$
=min$\{\{1 - f_N(f), 1 - f_M(f)\}, \{1 - f_N(g), 1 - f_M(g)\}\}$
=$\{1 - f_{N\cap M}(f), 1 - f_{N\cap M}(g)\}$

$t_{N\cap M}(f\delta g) = \{t_N(f\delta g), t_M(f\delta g)\}$
$\geq$
$\{\{t_N(f), t_N(g)\}, \{t_M(f), t_M(g)\}\}$

=min$\{\{t_N(f), t_M(f)\}, \{t_N(g), t_M(g)\}\}$
=$\{t_{N\cap M}(f), t_{N\cap M}(g)\}$ and

$1 - f_{N\cap M}(f\delta g) = \{1 - f_N(f\delta g), 1 - f_M(f\delta g)\}$
$\geq \{\{1 - f_N(f), 1 - f_N(g)\}, \{1 - f_M(f), 1 - f_M(g)\}\}$

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$=\min\{\{1-f_N(f),1-f_M(f)\},\{1-f_N(g),1-f_M(g)\}\}$

$=\{1-f_{N\cap M}(f),1-f_{N\cap M}(g)\}$

Now,

If $f \leq g$ $then$ $t_N(f) \geq t_N(g)$ and

$$t_M(f) \geq t_M(g)$$

$$t_{N\cap M}(f) = \{t_N(f), t_M(f)\}$$

$$\geq \{t_N(g), t_M(g)\}$$

$$= t_{N\cap M}(g)$$

Therefore $t_{N\cap M}(f) \geq t_{N\cap M}(g)$

And

$$1 - f_{N\cap M}(f) = \{1 - f_N(f), 1 - f_M(f)\} \geq \{1 - f_N(g), 1 - f_M(g)\}$$

$$= 1 - f_{N\cap M}(g)$$

Therefore $1 - f_{N\cap M}(f) \geq 1 - f_{N\cap M}(g)$

Hence $N \cap M$ is a $VOGNR$ of $\widetilde{K}$.

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IV. CONCLUSION

Conclusion: In this paper, we inspected the idea of $VOGNR$. We established one-one correspondence between $VOGNR$and crisp $OGNR$. We showed that the intersection of two $VOGNRs$ is also a $VOGNR$.

V. ACKNOWLEDGMENT

The authors are grateful to Prof. K.L.N. Swamy and Prof. I.B Ramabadra Sarma for their valuable suggestions and discussions on this work.

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