L-FUZZY SOFT INTERSECTION ACTION ON NEAR –RINGS

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Abstract: In this paper, we introduce a new kind of action on a soft ring called lattice fuzzy soft intersection action on a ring. We then focused on the concepts of lattice fuzzy soft intersection action on a ideal , sum, difference, product of two soft sets, negation of a soft set. Also, we derive its various related properties. We then study and discuss its structural characteristics.

Key words: Soft sets, lattice ordered group, L-fuzzy soft set, L- fuzzy soft intersection action on a soft ring, L-fuzzy soft intersection action on ideal, Homomorphisms of L-fuzzy soft intersection ,t-inclusion.

I.INTRODUCTION

L.A. Zadeh [33] introduced the notion of a fuzzy subset μ_A set S as a function from X into I = [0, 1]. Rosenfeld [28] applied this concept in group theory and semi group theory, and developed the theory of fuzzy subgroups and fuzzy sub semi], replaced the valuations set [0, 1], by means of a complete lattice in an attempt to make a generalized study of fuzzy set theory by studying L-fuzzy sets. In fact it seems in order to obtain a complete analogy of crisp mathematics in terms of fuzzy mathematics, it is necessary to replace the valuation set by a system having more rich algebraic structure. These concepts -groups play a major role in mathematics and fuzzy mathematics. G.S.V Satya Saibaba [29] introduced the concept of L- fuzzy λ-group and L-fuzzy λ-ideal of λ-group .To solve complex problems in economy, engineering, environmental science and social science, the methods in classical mathematics may not be successfully modeled because of various types of uncertainties. There are some mathematical theories for dealing with uncertainties such as; fuzzy set theory [32], soft set theory [21], fuzzy soft set theory [17] and so on. Soft set theory [21] was firstly introduced by Molodtsov in 1999 as a general mathematical tool for dealing with uncertainty. At present, research works on the soft set theory and its applications are making progress rapidly. The operations of soft sets are defined in [1, 7, 18, 22]. The algebraic structures of soft sets have been studied by some authors [3, 10, 13, 14, 15, 16, 17]. By embedding the ideas of fuzzy sets, many interesting applications of soft set theory have been expanded [6, 8, 28, 29, 17, 22, 25, 26, 27, 30]. And also algebraic structures of fuzzy soft sets have been studied [4, 33, 18, 20, 31, 23]. In this paper, we introduce a new kind of soft ring called Lattice fuzzy soft intersection action on a ring. We then focused on the concepts of Lattice fuzzy soft intersection action on a ideal, sum, difference, product of two soft sets, negation of a soft set. Also, we derive its various related properties. We then study and discuss its structural characteristics.

II.PRELIMINARIES

In this section, we recall some basic notions relevant to near-ring modules (N-modules) and fuzzy soft sets. By a near-ring, we shall mean an algebraic system (N,+,.),where

(N_1) (N, +) forms a group (not necessarily abelian)

(N_2) (N, .) Forms a semi group and

(N_3) (x + y) z = xz + yz for all x,y,z ∈ N. (that is we study on right Near-ring modules)

Throughout this paper, N will always denote right near-ring. A normal subgroup H of N is called a left ideal of N if n(s+h)-ns ∈ H for all n, s ∈ N and h ∈ I and denoted by $H \lhd_{\ell} N$. For a near-ring N, the zero-symmetric part of N denoted by N_0 is defined by N_0= {n∈ S / n0=0}.

Let (S,+) be a group and A: N×S →S, (n,s) → s.

(S,A) is called N-module or near-ring module if for all x,y ∈ N,for all s ∈ S.

(i) x(ys) = (xy)s

(ii) (x+y)s = xs+ys. It is denoted by N^S. Clearly N itself is an N-module by natural operations. A subgroup T of N^S with NT⊆T is said to be N-sub module of S and denoted by $T \leq_N S$. A normal subgroup T of S is called an N-ideal of N^S and denoted by a near-ring, S and χ two N-modules. Then h: S→χ is called an N-homomorphism if s,δ ∈ S, for all n∈ N,

(i) h (s+δ) = h(s)+h(δ) and

(ii) h (ns) = nh(s).

For all undefined concepts and notions we refer to (28). From now on, U refers to on initial universe, E is a set of parameters P (U) is the power set of U and A,B,C⊆ E.

Throughout this section, Ω denotes on arbitrary ring with the additive identity element0_R. If R is a division ring, then the multiplicative identity element of Ω will be denoted by1_Ω.

2.1. Definition [1]: A pair (F,A) is called a soft set over U, where F is a mapping given by F : A→P(U).

In other words, a soft set over U is a parameterized family of subsets of the universe U. Note that a soft set (F, A) can be denoted by F_A. In this case, when we define more than one soft set in some subsets A, B, C of parameters E, the soft sets will be denoted by F_A, F_B, F_C, respectively. On the other case, when we define more than one soft set in a subset A of the set of parameters E, the soft sets will be denoted by F_A,G_A, H_A, respectively. For more details, we refer to [11,17,18,26,29,7].

2.2. Definition [21] :The relative complement of the soft set F_A over U is denoted by $F^r{}_A$, where $F^r{}_A : A \rightarrow P(U)$ is a mapping given as $F^r{}_A(a) = U \setminus F_A(a)$, for all a ∈ A.

2.3. Definition [21]: Let F_A and G_B be two soft sets over U such that A∩B ≠ ∅,. The restricted intersection of F_A and G_B is denoted by $F_A \Cup G_B$, and is defined as $F_A \Cup G_B$ = (H,C), where C = A∩B and for all c ∈ C, H(c) = F(c) ∩ G(c).

2.4. Definition [21]: Let F_A and G_B be two soft sets over U such that A∩B ≠ ∅,. The restricted union of F_A and G_B is denoted by $F_A \cup_R G_B$, and is defined as $F_A \cup_R G_B$ = (H,C),where C = A∩B and for all c ∈ C, H(c) = F(c)∪G(c).

2.5 Definition [12]: Let F_A and G_B be soft sets over the common universe U and ψbe a function from A to B. Then we can define the soft set ψ (F_A) over U, where ψ (F_A) : B→P(U) is a set valued function defined by $\psi (F_A)(b) = \cup\{F(a) \mid a \in A \text{ and } \psi(a) = b\}$,

if$\psi^{-1}(b) \neq \emptyset$, = 0 otherwise for all b ∈ B. Here, ψ (F_A) is called the soft image of F_A under ψ. Moreover we can define a soft set $\psi^{-1}(G_B)$ over U, where

$\psi^{-1}(G_B) : A \rightarrow P(U)$ is a set-valued function defined by $\psi^{-1}(G_B)(a) = G(\psi(a))$ for all a ∈ A. Then, $\psi^{-1}(G_B)$ is called the soft pre image (or inverse image) of G_B under ψ.

2.6. Definition [16]: Let F_A and G_B be soft sets over the common universe U and ψ be a function from A to B. Then we can define the soft set $\psi^\star(F_A)$ over U, where

$\psi^{\star}(F_A) : B \to P(U)$ is a set−valued function defined by $\psi^{\star}(F_A)(b) = \cap\{F(a) \mid a \in A \text{ and } \psi(a) = b\}$, if $\psi^{-1}(b) \neq \emptyset, = 0$ otherwise for all b ∈ B.Here,$\psi^{\star}(F_A)$ is called the soft anti image of F_A under ψ.

2.7 Definition [29]: A lattice ordered group is a system G = (G, *, ≤) where (i) (G, *) is a group (ii) (G, ≤) is a lattice and (iii) the inclusion is invariant under all translations x = x*a*b. that is x ≤ y implies a*x*b ≤ a*y*b for all a,b ϵ G.

2.8 Definition: A L-fuzzy subset μ of G is said to be a L-fuzzy soft intersection (SI) action of a near-ring over U if for any x,y ϵ G

(i) $f_\Omega(x-y) \supseteq f_\Omega(x) \cap f_\Omega(y)$,

(ii) $f_\Omega(-x) \supseteq f_\Omega(x)$

(iii) $f_\Omega(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$,

(iv) $f_\Omega(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$.

2.7 Definition: Let Ω be a ring with respect to two binary operations '+', '.' and $f_\Omega \in S(I)$. f_Ω is called a L-fuzzy soft intersection ring R over U, if f_Ω is a L-fuzzy soft intersection groupoid over U for the binary operation '+' in S(I) induced by '+' in Ω, and f_Ω is a L-fuzzy soft groupoid over U for the binary operation '.' in S(I) induced by '.' in Ω.

III. Properties of L-fuzzy soft intersection ring R and L-fuzzy soft intersection ideal I.

3.1.Theorem: Let Ω be a ring and $f_\Omega \in S(U)$, then f_Ω is called L-fuzzy soft intersection ring R over U iff

(v) $f_\Omega(x-y) \supseteq f_\Omega(x) \cap f_\Omega(y)$,

(vi) $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y ∈ Ω.

(vii) $f_\Omega(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$,

(viii) $f_\Omega(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y ∈ Ω.

Proof: Suppose that f_Ω is L-fuzzy soft intersection ring R over U. Then we have $f_\Omega(x-y \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $f_\Omega(-x) = f_\Omega(x)$. Hence $f_\Omega(x-y) \supseteq f_\Omega(x) \cap f_\Omega(-y) = f_\Omega(x) \cap f_\Omega(y)$. Moreover, as f_Ω is a L-fuzzy soft intersection ring R over U, then we have $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$.

Conversely, suppose that $f_\Omega(x-y) \supseteq f_\Omega(x) \cap f_\Omega(y)$, $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y ∈ Ω. Choosing $x = 0_\Omega$ yields $f_\Omega(0_\Omega - y) = f_\Omega(-y) = f_\Omega(y)$. And $f_\Omega(y) = f_\Omega(-(-y)) \supseteq f_\Omega(-y)$ for all y ∈ Ω. Thus $f_\Omega(-x) = f_\Omega(x)$ for all x ∈ Ω. Also, $f_\Omega(x+y) = f_\Omega(x-(-y)) \supseteq f_\Omega(x) \cap f_\Omega(-y) = f_\Omega(x) \cap f_\Omega(y)$.

Similarly we can prove $f_\Omega(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $f_\Omega(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all $x,y \in \Omega$.Therefore, f_Ω is called L-fuzzy soft intersection ring R over U.

3.1Definition: Let Ω be a ring. Then L-fuzzy soft intersection ring R f_Ω is called a L-fuzzy soft intersection left ideal over U, if $f_\Omega(xy) \supseteq f_\Omega(y)$ for all $x,y \in \Omega$ and f_Ω is called a L-fuzzy soft intersection right ideal over U, if $f_\Omega(xy) \supseteq f_\Omega(x)$ for all $x,y \in \Omega$. If f_Ω is a L-fuzzy soft intersection left ideal and right ideal over U, then f_Ω is called to be a L-fuzzy soft intersection ideal I over U.

3.2Theorem: Let Ω be a ring and $f_\Omega \in S(U)$, then f_Ω is called L-fuzzy soft intersection ideal I over U iff

$f_\Omega(x\text{-}y) \supseteq f_\Omega(x) \cap f_\Omega(y)$, (ii) $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all $x,y \in \Omega$. **(1)**

Proof: Suppose that f_Ω is called L-fuzzy soft intersection ideal I over U. Then, we have $f_\Omega(x\text{-}y \supseteq f_\Omega(x) \cap f_\Omega(y)$ Moreover,

since $f_\Omega(xy) \supseteq f_\Omega(x)$ and $f_\Omega(xy \supseteq f_\Omega(y) \cup$ it follows that $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$.

Similarly we can prove $f_\Omega(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and

$f_\Omega(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all $x,y \in \Omega$.

Conversely, suppose that $f_\Omega(x\text{-}y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $f_\Omega(xy) \supseteq f_\Omega(x) \cup f_\Omega(y)$ for all $x,y \in \Omega$. Thus

$f_\Omega(x\ \ y) \supseteq f_\Omega(x) \cap f_\Omega(y) \supseteq f_\Omega(x)$, $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y) \supseteq f_\Omega(y)$ and $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$.Therefore, f_Ω is called L-fuzzy soft intersection ideal I over U.

3.1. Proposition: If f_Ω is L-fuzzy soft intersection ideal I over U, then $f_\Omega(0_\Omega) \supseteq f_\Omega(x)$, for all $x \in \Omega$.

Proof: Suppose that f_Ω is called L-fuzzy soft intersection ideal I over U. Then, for all $x \in \Omega$,

$$f_\Omega(0_\Omega) = f_\Omega(x - x) \supseteq f_\Omega(x) \cup f_\Omega(x) \supseteq f_\Omega(x) \quad \textbf{(2)}$$

3.2. Proposition: Let Ω be a ring with identity. If f_Ω is L-fuzzy soft intersection ideal I over U, then $f_\Omega(x) \supseteq f_\Omega(1_\Omega)$, for all $x \in \Omega$. **(3)**

Proof: Suppose that f_Ω is L-fuzzy soft intersection ideal I over U.

Then, for all $x \in \Omega$, $f_\Omega(x) = f_\Omega(x1_\Omega) \supseteq f_\Omega(1_\Omega)$.

3.3. Theorem: Let R be a division ring and $f_\Omega \in S(U)$. Then f_Ω is L-fuzzy soft intersection ideal I over U iff $f_\Omega(x) = f_\Omega(1_\Omega) \subseteq f_\Omega(0_\Omega)$ for all $0_\Omega \neq x \in \Omega$.

Proof: Suppose that f_Ω is L-fuzzy soft intersection ideal I over U. Since $f_\Omega(0_\Omega) \supseteq f_\Omega(x)$ for all $x \in \Omega$, then in particular $f_\Omega(0_\Omega) \supseteq f_\Omega(1_\Omega)$.

Now, let $0_\Omega \neq x \in \Omega$, $f_\Omega(x) = f_\Omega(x1_\Omega) \supseteq f_\Omega(1_\Omega)$ and $f_\Omega(1_\Omega) = f_\Omega(xx^{-1}) \supseteq f_\Omega(x)$.

It follows that $f_\Omega(x) = f_\Omega(1_\Omega) \subseteq f_\Omega(0_\Omega)$

Conversely,

(i).Let x,y$\in \Omega$. If x-y $\neq 0_\Omega$, then $f_\Omega(x-y) = f_\Omega(1_\Omega) = f_\Omega(x) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and if x-y $= 0_\Omega$, then $f_\Omega(x-y) = f_\Omega(0_\Omega) \supseteq f_\Omega(x) \supseteq f_\Omega(x) \cap f_\Omega(y)$.

(ii) Let x,y$\in \Omega$. If $x \neq 0_\Omega$ and $y = 0_\Omega$, then $f_\Omega(xy) = f_\Omega(0_\Omega) \supseteq f_\Omega(1_\Omega) = f_\Omega(x)$ and $f_\Omega(xy) = f_\Omega(0_\Omega) \supseteq f_\Omega(1_\Omega) = f_\Omega(y)$. Thus $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$

(ii)Let x,y$\in \Omega$. If $x \neq 0_\Omega$ and $y \neq 0_\Omega$, then either $xy \neq 0_\Omega$ or $xy = 0_\Omega$.

If $xy \neq 0_\Omega$, then $f_\Omega(xy) = f_\Omega(1_\Omega) = f_\Omega(x)$ and $f_\Omega(xy) = f_\Omega(1_\Omega) = f_\Omega(y)$.

If $xy = 0_\Omega$, then $f_\Omega(xy) = f_\Omega(0_\Omega) \supseteq f_\Omega(x)$ and $f_\Omega(xy) = f_\Omega(0_\Omega) \supseteq f_\Omega(y)$.

Thus $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y)$ implying that f_Ω is L-fuzzy soft intersection ideal I over U.

Remark: The above theorem 3.3 shows that in a division ring a L-fuzzy soft intersection left ideal I in a L-fuzzy soft intersection right ideal I

3.4. Theorem: Let f_Ω be L-fuzzy soft intersection ring R / ideal over U. If $f_\Omega(x-y) = f_\Omega(0_\Omega)$ for any x,y $\in \Omega$, then $f_\Omega(x) = f_\Omega(y)$

Proof: Assume that $f_\Omega(x-y) = f_\Omega(0_\Omega)$ for any x,y $\in \Omega$. Then

$$f_\Omega(x) = f_\Omega(x-y+y) \supseteq f_\Omega(x-y) \cup f_\Omega(y) = f_\Omega(0_\Omega) \cup f_\Omega(y) = f_\Omega(y) \quad \textbf{(4)}$$

Similarly, using $f_\Omega(x-y) = f_\Omega(-(y-x)) = f_\Omega(y-x) = f_\Omega(0_\Omega)$, we have $f_\Omega(y) \supseteq f_\Omega(x)$ **(5)**

Thus the proof is completed.

3.3. Proposition: Let f_Ω be L-fuzzy soft intersection ring R/ ideal over U such that the image of f_Ω is ordered by inclusion for all x $\in \Omega$. If $f_\Omega(y) \supset f_\Omega(x)$ for x,y $\in \Omega$,

then $f_\Omega(x-y) = f_\Omega(x) = f_\Omega(y-x)$.

Proof: Assume that $f_\Omega(y) \supseteq f_\Omega(x)$ for x,y $\in \Omega$. Then

$$f_\Omega(x-y) \supseteq f_\Omega(x) \cap f_\Omega(y) = f_\Omega(x) \text{ and}$$

$$f_\Omega(x) = f_\Omega(x-y+y) \supseteq f_\Omega(x-y) \cup f_\Omega(y)$$

Since, $f_\Omega(y) \supset f_\Omega(x)$ and $f_\Omega(x) \supseteq f_\Omega(x-y) \cup f_\Omega(y)$,for x,y $\in \Omega$,

then $f_\Omega(x-y) \supseteq f_\Omega(x)$. It follows that $f_\Omega(x-y) = f_\Omega(x) = f_\Omega(y-x)$.

3.5Theorem: Let f_{Ω} be L-fuzzy soft intersection ring R / ideal over U with Im $f_{\Omega} = (\emptyset, \alpha)$, where $\emptyset \neq \alpha \subseteq$ U. If $f_{\Omega} = g_{\Omega} \tilde{\cup} h_{\Omega}$ where g_{Ω} and h_{Ω} are L-fuzzy soft intersection ideal I over U then either $g_{\Omega} \subseteq h_{\Omega}$ or $h_{\Omega} \tilde{\subseteq} g_{\Omega}$.

Proof: To obtain a proof by contradiction, assume that $g_{\Omega}(x) \supset h_{\Omega}(x)$ and $h_{\Omega}(y) \supset g_{\Omega}(y)$ for x,y $\in \Omega$.

As $f_{\Omega} = g_{\Omega} \tilde{\cup} h_{\Omega}$, therefore $f_{\Omega}(x) = g_{\Omega}(x) \supset h_{\Omega}(x) \supseteq \emptyset$.

And $f_{\Omega}(y) = h_{\Omega}(y) \supset g_{\Omega}(y) \supseteq \emptyset$. Since Im $f_{\Omega} = (\emptyset, \alpha)$, it follows that $f_{\Omega}(x) = \alpha = f_{\Omega}(y) = g_{\Omega}(x) = h_{\Omega}(y) = f_{\Omega}(x\text{-}y)$. From proposition 3.3 and the facts that $g_{\Omega}(y) \subseteq m = g_{\Omega}(x)$ and $h_{\Omega}(x) \subseteq m = h_{\Omega}(y)$. Thus $g_{\Omega}(x-y) = g_{\Omega}(y)$ and $h_{\Omega}(x-y) = g_{\Omega}(x)$. So that $f_{\Omega}(x-y) = g_{\Omega}(y) \cup h_{\Omega}(x) \supseteq$ m, the desired contradiction.

IV. Properties of product of L-fuzzy soft intersection ring R and L-fuzzy soft intersection ideal I

4.1. Theorem: Let f_{Ω} and f_{χ} be two L-fuzzy soft intersection ring R over U. Then $f_{\Omega} \wedge f_{\chi}$ is L-fuzzy soft intersection ring R R over U.

Proof: Let $(x_1, y_1), (x_2, y_2) \in \Omega \times \chi$. Then

$$\begin{aligned} f_{\Omega\wedge\chi}((x_1, y_1) - (x_2, y_2)) &= f_{\Omega\wedge\chi}(x_1\text{-}x_2, y_1\text{-}y_2) \\ &= f_{\Omega}(x_1\text{-}x_2) \cap f_{\chi}(y_1\text{-}y_2) \\ &\supseteq (f_{\Omega}(x_1) \cap f_{\Omega}(x_2)) \cap (f_{\chi}(y_1) \cap f_{\chi}(y_2)) \\ &= ((f_{\Omega}(x_1) \cap f_{\chi}(y_1))) \cap ((f_{\Omega}(x_2) \cap f_{\chi}(y_2))) \\ &= f_{\Omega\wedge\chi}(x_1, y_1) \cap f_{\Omega\wedge\chi}(x_2, y_2) \end{aligned} \quad \textbf{(6)}$$

And

$$\begin{aligned} f_{\Omega\wedge\chi}((x_1, y_1)(x_2, y_2)) &= f_{\Omega\wedge\chi}(x_1x_2, y_1y_2) \\ &= f_{\Omega}(x_1x_2) \cap f_{\chi}(y_1y_2) \\ &\supseteq (f_{\Omega}(x_1) \cap f_{\Omega}(x_2)) \cap (f_{\chi}(y_1) \cap f_{\chi}(y_2)) \\ &= ((f_{\Omega}(x_1) \cap f_{\chi}(y_1)) \cap ((f_{\Omega}(x_2) \cap f_{\chi}(y_2))) \quad \textbf{(7)} \\ &= f_{\Omega\wedge\chi}(x_1, y_1) \cap f_{\Omega\wedge\chi}(x_2, y_2) \end{aligned}$$

Similarly we can prove

$$f_{\Omega}(x \vee y) \supseteq f_{\Omega}(x) \cap f_{\Omega}(y) \text{ and } f_{\Omega}(x \wedge y)) \supseteq f_{\Omega}(x) \cap f_{\Omega}(y) \text{ for all } x,y \in \Omega. \quad \textbf{(8)}$$

Therefore, $f_{\Omega} \wedge f_{\chi}$ is L-fuzzy soft intersection ring R over U. Note that $f_{\Omega} \vee f_{\chi}$ is not L-fuzzy soft intersection ring R over U.

4.1. Example: Assume that U = S_3 is the universal set. Let Ω = Z_5 and $\chi = \left\{\begin{pmatrix} a & a \\ b & b \end{pmatrix} / a, b \in Z_2\right\}$, 2 ×2 matrices with Z_5 terms, be sets of parameters.

We define L-fuzzy soft intersection ring R f_Ω over U= S_3 by

$f_\Omega(0) = S_3$, $f_\Omega(1)$ = { (1), (1 2), (1 3 2) }, $f_\Omega(2)$ = { (1), (1 2), (1 2 3),(1 3 2) },

$f_\Omega(3)$ = { (1), (1 2), (1 2 3),(1 3 2) }, $f_\Omega(4)$ = { (1), (1 2), (1 3 2) }

We define (α,β)-soft ring f_χ over U= S_3 by

$f_\chi\left(\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}\right) = S_3$,

$f_\chi\left(\begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix}\right)$ = { (1), (1 2), (1 3 2) }, **(9)**

$f_\chi\left(\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}\right)$= { (1), (1 3), (1 3 2) }, **(10)**

$f_\chi\left(\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}\right)$= { (1), (1 2 3),(1 3 2) }. **(11)**

Then $f_\Omega \vee f_\chi$ is L-fuzzy soft intersection ring R over U.

4.2. Theorem: Let f_Ω and f_χ be two L-fuzzy soft intersection ideals I over U. Then $f_\Omega \wedge f_\chi$ is L-fuzzy soft intersection ideal I over U.

Proof: We showed that if f_Ω and f_χ are two L-fuzzy soft intersection ring R R over U.

then $f_\Omega \wedge f_\chi$ is L-fuzzy soft intersection ring R over U in the theorem 4.1. Let (x_1, y_1), (x_2, y_2) $\in \Omega \times \chi$. Then,

$$f_{\Omega\wedge\chi}((x_1, y_1)(x_2, y_2)) = f_{\Omega\wedge\chi}(x_1x_2, y_1y_2) = f_\Omega(x_1x_2) \cap f_\chi(y_1y_2)$$
$$\supseteq f_\Omega(x_1) \cap f_\chi(y_1) = f_{\Omega\wedge\chi}(x_1, y_1) \quad \textbf{(12)}$$

And $$f_{\Omega\wedge\chi}((x_1, y_1)(x_2, y_2)) = f_{\Omega\wedge\chi}(x_1x_2, y_1y_2) = f_\Omega(x_1x_2) \cap f_\chi(y_1y_2)$$
$$\supseteq f_\Omega(x_2) \cap f_\chi(y_2) = f_{\Omega\wedge\chi}(x_2, y_2) . \quad \textbf{(13)}$$

Similarly we can prove $f_\Omega(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $f_\Omega(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y ∈ Ω. Therefore, $f_\Omega \wedge f_\chi$ is L-fuzzy soft intersection ideal I over U. Note that $f_\Omega \vee f_\chi$ is not L-fuzzy soft intersection ideal I over U.

4.3. Theorem: Let f_Ω and g_Ω be two **L**-fuzzy soft intersection ring R over U. Then $f_\Omega \tilde{\cap} g_\Omega$ is L-fuzzy soft intersection ring R over U.

Proof: Let x,y ∈ Ω. Then,

$$(f_\Omega \tilde{\cap} g_\Omega)(x\text{-}y) = f_\Omega(x\text{-}y) \cap g_\Omega(x\text{-}y) \supseteq (f_\Omega(x) \cap f_\Omega(y)) \cap (g_\Omega(x) \cap g_\Omega(y))$$

$$= (f_\Omega(x) \cap g_\Omega(x)) \cap (f_\Omega(y) \cap g_\Omega(y))$$

$$= (f_\Omega \tilde{\cap} g_\Omega)(x) \cap (f_\Omega \tilde{\cap} g_\Omega)(y) \quad \textbf{(14)}$$

$$(f_\Omega \tilde{\cap} g_\Omega)(xy) = f_\Omega(xy) \cap g_\Omega(xy) \supseteq (f_\Omega(x) \cap f_\Omega(y)) \cap (g_\Omega(x) \cap g_\Omega(y))$$

$$= (f_\Omega(x) \cap g_\Omega(x)) \cap (f_\Omega(y) \cap g_\Omega(y))$$

$$= (f_\Omega \tilde{\cap} g_\Omega)(x) \cap (f_\Omega \tilde{\cap} g_\Omega)(y)\,. \quad \textbf{(15)}$$

Similarly we can prove $(f_\Omega \tilde{\cap} g_\Omega)(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $(f_\Omega \tilde{\cap} g_\Omega)(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all $x,y \in \Omega$.Therefore, $f_\Omega \tilde{\cap} g_\Omega$ is L-fuzzy soft intersection ring R over U.

4.4 Theorem: Let f_Ω and g_Ω be two L-fuzzy soft intersection ideals I over U. Then $f_\Omega \tilde{\cap} g_\Omega$ is L-fuzzy soft intersection ideal I over U.

Proof: In the above theorem 4.1, we showed that f_Ω and g_Ω are two L-fuzzy soft intersection ring R over U, Then $f_\Omega \tilde{\cap} g_\Omega$ is L-fuzzy soft intersection ring R over U.

Let $x,y \in \Omega$. Then,

$$(f_\Omega \tilde{\cap} g_\Omega)(xy) = f_\Omega(xy) \cap g_\Omega(xy) \supseteq f_\Omega(x) \cap g_\Omega(x)$$

$$= (f_\Omega \tilde{\cap} g_\Omega)(x)$$

And $$(f_\Omega \tilde{\cap} g_\Omega)(xy) = f_\Omega(xy) \cap g_\Omega(xy) \supseteq (f_\Omega(x) \cap f_\Omega(y)) \cap (g_\Omega(x) \cap g_\Omega(y))$$

$$= (f_\Omega \tilde{\cap} g_\Omega)(x) \cap (f_\Omega \tilde{\cap} g_\Omega)(y)\,.$$

Similarly we can prove $(f_\Omega \tilde{\cap} g_\Omega)(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $(f_\Omega \tilde{\cap} g_\Omega)(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all $x,y \in \Omega$.

Therefore, $f_\Omega \tilde{\cap} g_\Omega$ is L-fuzzy soft intersection ideal I over U.

V. Homomorphisms of L-fuzzy soft intersection ring R and L-fuzzy soft intersection ideal

5.1. Theorem: Let f_Ω be L-fuzzy soft intersection ring R over U and 'h' be a surjective homomorphism from Ω to χ. Then $h(f_\Omega)$ is L-fuzzy soft intersection ring R over U.

Proof: Since 'h' is a surjective homomorphism from Ω to χ, there exist $x,y \in \Omega$ such that $u=h(x)$ and $v=h(y)$ for all $u,v \in \chi$. Then

$$(h(f_\Omega))(u-v) = \cup\{f_\Omega(z), z \in \Omega, h(z) = u - v\}$$

$$= \cup\{f_\Omega(x-y)\,; x,y \in \Omega, u = h(x), v = h(y)\}$$

$$\supseteq \cup\{f_\Omega(x) \cap f_\Omega(y)\,; x,y \in \Omega, u = h(x), v = h(y)\}$$

$$= \{\cup\{f_\Omega(x); x \in \Omega, u = h(x)\}\} \cap \{\cup\{f_\Omega(y); y \in \Omega, v = h(y)\}\}$$

$$= (h(f_\Omega))(u) \cap (h(f_\Omega))(v) \quad \textbf{(16)}$$

And ,

$$(h(f_\Omega))(uv) = \cup \{f_\Omega(z), z \in \Omega, h(z) = uv\}$$
$$= \cup \{f_\Omega(xy) ; x, y \in \Omega , u = h(x), v = h(y)\}$$
$$\supseteq \cup \{f_\Omega(x) \cap f_\Omega(y) ; x, y \in \Omega , u = h(x), v = h(y)\}$$
$$= \{\cup \{f_\Omega(x); x \in \Omega , u = h(x)\}\}\cap\{\cup \{f_\Omega(y); y \in \Omega , v = h(y)\}\}$$
$$= (h (f_\Omega))(u) \cap (h(f_\Omega))(v) \quad \textbf{(17)}$$

Similarly we can prove $(h (f_\Omega)) ((x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $(h(f_\Omega))(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y $\in \Omega$. Hence, h (f_Ω) is a of L-fuzzy soft intersection ring R over U.

5.2.Theorem: Let f_Ω be L-fuzzy soft intersection ideal I over U and 'h' be a surjective homomorphism fromΩ to χ. Then h (f_Ω) is a L-fuzzy soft intersection ideal I over U.

Proof: We know that h (f_Ω) is L-fuzzy soft intersection ring R over U, under these conditions as shown in the above theorem. Suppose that u=h(x) and v=h(y) for some x,y $\in \Omega$ such that u,v $\in \chi$. Then

$$(h(f_\Omega))(uv) = \cup \{f_\Omega(z), z \in \Omega, h(z) = uv\} = \cup \{f_\Omega(xy) ; x, y \in \Omega , u = h(x), v = h(y)\}$$
$$\supseteq \cup \{f_\Omega(x) ; x \in \Omega , u = h(x)\} = (h(f_\Omega))(u)$$

and

$$(h (f_\Omega))(uv) = \cup \{f_\Omega(z), z \in \Omega, h(z) = uv\} = \cup \{f_\Omega(xy) ; x, y \in \Omega , u = h(x), v = h(y)\}$$
$$\supseteq \cup \{f_\Omega(y) ; y \in \Omega , v = h(y)\} = (h(f_\Omega))(v),$$

Hence, h (f_Ω) is a L-fuzzy soft intersection ideal I over U.

5.3. Theorem: Let f_χ be **L**-fuzzy soft intersection ring R over U and 'h' be a homomorphism fromΩ to χ. Then $h^{-1}(f_\chi)$ is a of L-fuzzy soft intersection ring R over U.

Proof: Let x,y $\in \Omega$. Then

$$h^{-1}(f_\chi) (x\text{-}y) = f_\chi (h(x\text{-}y)) = f_\chi (h(x)\text{-}h(y))$$
$$\supseteq f_\chi (h(x)) \cap f_\chi (h(y)) = h^{-1}(f_\chi) (x) \cap h^{-1}(f_\chi) (y) \text{ and,}$$
$$h^{-1}(f_\chi) (xy) = f_\chi (h(xy)) = f_\chi (h(x)h(y))$$
$$\supseteq f_\chi (h(x)) \cap f_\chi (h(y)) = h^{-1}(f_\chi) (x) \cap h^{-1}(f_\chi) (y) .$$

Similarly we can prove $h^{-1}(f_\chi) (x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $h^{-1}(f_\chi) (x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y $\in \Omega$.

Hence, $h^{-1}(f_\chi)$ is a **L**-fuzzy soft intersection ring R over U.

5.4, Theorem: Let f_χ be L-fuzzy soft intersection ideal I over U and 'h' be a homomorphism fromΩ to χ. Then $h^{-1}(f_\chi)$ is a L-fuzzy soft intersection ideal I over U.

Proof: We know that $h^{-1}(f_\chi)$ is a L-fuzzy soft intersection ring R over U, under these conditions as shown in the above theorem 5.3. Then for all x,y ∈ Ω,

$$h^{-1}(f_\chi)\,(xy) = f_\chi\,(h(xy)) \supseteq f_\chi\,(h(x)) = h^{-1}(f_\chi)\,(x) \text{ And}$$

$$h^{-1}(f_\chi)\,(xy) = f_\chi\,(h(xy)) \supseteq f_\chi\,(h(y)) = h^{-1}(f_\chi)\,(y)$$

Hence, $h^{-1}(f_\chi)$ is a L-fuzzy soft intersection ideal I over U.

5.1Definition: Let Ω be a ring and f_Ω, g_Ω ∈S(U). Then$f_\Omega \mp g_\Omega$, $-f_\Omega$, $f_\Omega g_\Omega$ ∈ S(I) are defined as follows;

$$(f_\Omega \mp g_\Omega)\,(x) = \cup\{f_\Omega(y) \cap g_\Omega(z) \,/\, y,z \in \Omega,\ y \mp z = x\}$$

$$(-f_\Omega)\,(x) = f_\Omega(-x)$$

$$(f_\Omega g_\Omega)\,(x) = \cup\{f_\Omega(y) \cap g_\Omega(z) \,/\, y,z \in \Omega,\ yz = x\} \text{ for all } x \in \Omega.$$

$f_\Omega + g_\Omega$, $f_\Omega - g_\Omega$, $f_\Omega g_\Omega$ are called sum, difference and product of $f_\Omega$and g_Ω, respectively , and $-f_\Omega$ is called the negative of f_Ω.

5.5. Theorem: Let Ω be a ring and $f_\Omega, g_\Omega, h_\Omega$ ∈ S(U). then $f_\Omega(g_\Omega + h_\Omega) \subseteq (f_\Omega g_\Omega + f_\Omega h_\Omega)$.

Proof: Assume that w∈ Ω and u, v ∈ Ω such that uv=w. Then

$$f_\Omega(g_\Omega + h_\Omega)(w) = \cup\{f_\Omega(u) \cap (g_\Omega + h_\Omega)(v) \,/\, u,v \in \Omega,\ uv=w\} \text{ and}$$

$$\begin{aligned} f_\Omega(u) \cap (g_\Omega + h_\Omega)(v) &= f_\Omega(u) \cap \{\cup\{g_\Omega(y) \cap h_\Omega(z) \,/\, y,z \in \Omega\ ,\ y+z=v\} \\ &= \cup\ \{(f_\Omega(u) \cap g_\Omega(y)) \cap (f_\Omega(u) \cap h_\Omega(z)) \,/\, y,z \in \Omega\ ,\ y+z=v\} \\ &= \cup\ \{(f_\Omega(u) \cap g_\Omega(y)) \cap (f_\Omega(u) \cap h_\Omega(z)) \,/\, y,z \in \Omega\ ,\ uy+uz=uv\} \\ &\subseteq \cup\ \{(f_\Omega g_\Omega)(uy) \cap (f_\Omega h_\Omega)(uz)) \,/\, y,z \in \Omega\ ,\ uy+uz=uv\} \\ &= (f_\Omega g_\Omega + f_\Omega h_\Omega)(w) \end{aligned} \tag{18}$$

Thus $f_\Omega(g_\Omega + h_\Omega)(w) \subseteq (f_\Omega g_\Omega + f_\Omega h_\Omega)(w)$ for all w∈R.

Hence, $f_\Omega(g_\Omega + h_\Omega) \subseteq (f_\Omega g_\Omega + f_\Omega h_\Omega)$.

5.6. Theorem: Let f_Ω is L-fuzzy soft intersection right ideal I and g_χ is L-fuzzy soft intersection left ideal I over U. Then $f_\chi g_\chi \subseteq f_\chi \widetilde{\cap}\, g_\chi$.

Proof: If $(f_\chi g_\chi)(x) = \emptyset$, then it is clear that $f_\chi g_\chi \subseteq f_\chi \widetilde{\cap}\, g_\chi$.

Suppose $(f_\chi g_\chi)(x) \neq \emptyset$ and

$$(f_\chi g_\chi)(x) = \cup\{f_\chi(y) \cap g_\chi(z) \ \,/\, y,z \in \Omega,\ x=yz\} \tag{19}$$

Since, f_Ω is L-fuzzy soft intersection right ideal I and g_χ is L-fuzzy soft intersection left ideal I over U, we have

$$f_\chi(x) = f_\chi(yz) \supseteq f_\chi(y) \text{ and } g_\chi(x) = g_\chi(yz) \supseteq g_\chi(z) \text{ . Hence}$$

$$(f_\chi g_\chi)(x) = \cup\{f_\chi(y) \cap g_\chi(z) \,/\, y,z\in \Omega,\ x=yz\} \subseteq f_\chi(x) \cap g_\chi(x) = (f_\chi \tilde{\cap}\, g_\chi)(x) \text{ .}$$

5.2. Definition: Let f_Ω is of L-fuzzy soft intersection ring R over U. Then centre-set of f_Ω, denoted by λf_Ω ,is defined as $\lambda f_\Omega = \{x\in \Omega \,;\, f_\Omega(x) = f_\Omega(0_\Omega)\}$.

5.7.Theorem: Let f_Ω be a of L-fuzzy soft intersection ring R over U.Then λf_Ω is a sub ring of Ω.

Proof: It is clear that $0_\Omega \in \lambda f_\Omega \subseteq \Omega$. Let x,y$\in \lambda f_\Omega$. Then we have $f_\Omega(x) = f_\Omega(y) = f_\Omega(0_\Omega)$.

It follows that , $\quad f_\Omega(x - y) \supseteq f_\Omega(x) \cap f_\Omega(y) = f_\Omega(0_\Omega) \cap f_\Omega(0_\Omega) = f_\Omega(0_\Omega)$

And $\quad f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y) = f_\Omega(0_\Omega) \cap f_\Omega(0_\Omega)$

$$= f_\Omega(0_\Omega) \text{ implying that } x - y,\ xy \in \lambda f_\Omega. \tag{20}$$

Therefore, λf_Ω is a sub ring of Ω.

Similarly we can prove $f_\Omega(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $f_\Omega(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y $\in \Omega$.

5.8. Theorem: Let f_Ω be a L-fuzzy soft intersection ideal I over U. Then λf_Ω is a ideal of Ω.

Proof: The proof can be made by using theorem 5.7

5.9. Theorem: Let f_Ω be a of L-fuzzy soft intersection ring R over U and $t \subseteq f_\Omega(0_\Omega)$.

Then $f_\Omega{}^t$ is a sub ring of Ω.

Proof: It is clear that $0_\Omega \in f_\Omega{}^t \subseteq \Omega$. Let x,y$\in f_\Omega{}^t$, then $f_\Omega(x) \supseteq t$ and $f_\Omega(y) \supseteq t$.

It follows that, $f_\Omega(x - y) \supseteq f_\Omega(x) \cap f_\Omega(y) \supseteq t$and $f_\Omega(xy) \supseteq f_\Omega(x) \cap f_\Omega(y) \supseteq t$

Thus$x - y,\ xy \in f_\Omega{}^t$. Therefore, $f_\Omega{}^t$ is a sub ring of Ω.

Similarly we can prove $f_\Omega(x \vee y) \supseteq f_\Omega(x) \cap f_\Omega(y)$ and $f_\Omega(x \wedge y)) \supseteq f_\Omega(x) \cap f_\Omega(y)$ for all x,y $\in \Omega$.

5.10 .Theorem: Let f_Ω be a L-fuzzy soft intersection ideal I over U and $t \subseteq f_\Omega(0_\Omega)$.Then $f_\Omega{}^t$ is an ideal of Ω.

Proof: The proof can be made by using theorem 5.9

VI.CONCLUSION

Here, we define of L-fuzzy soft intersection ring R that as alternative definition to soft rings. We then focused on the concepts of L-fuzzy soft intersection ideal I , sum, difference, product of two soft sets, negation of a soft set and study their properties. To extend over work, further research could be done in other algebraic structures such as fields ,modules as in the case of L-fuzzy soft intersection ring R.

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