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ALGEBRAIC PROPERTIES OF INTUITIONISTIC FUZZY IDEALS IN RING STRUCTURES

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Abstract

This work provides a thorough examination of intuitionistic fuzzy ideals, with an emphasis on investigating paradoxical translations and algebraic properties in various algebraic structures, especially in ring theory. Intuitionistic fuzzy sets, well known for their capacity to accurately represent uncertainty, are at the center of this study. The article explores the complex nature of conflicting translations and their consequences for intuitionistic fuzzy ideals within the context of intuitionistic fuzzy set theory. The research expands its scope to study the behavior of intuitionistic fuzzy ideals in other algebraic structures, such as semigroups and rings, going beyond conventional algebraic settings. This work advances theoretical knowledge and practical applications in fields where uncertainty plays a major role by revealing the complex relationships between contradicting translations and algebraic properties. All things considered, the work sheds important light on how intuitionistic fuzzy ideals behave, particularly inside ring structures, with consequences for algebraic theory and related topics.

Keywords: *Contrary Translations, Algebraic Properties, Intuitionistic, Fuzzy Ideals, Algebraic*

1. INTRODUCTION

Zadeh's 1965 introduction of fuzzy set theory, which offers a framework for handling uncertainty and imprecision, has had a profound impact on a number of mathematical and engineering domains. On top of this base, Atanassov proposed the idea of intuitionistic fuzzy sets (IFS) in 1986. IFS expand fuzzy sets by giving each element a degree of membership and a degree of non-membership. Because of their dual-degree structure, intuitionistic fuzzy sets are an effective tool for both theoretical research and real-world applications as they provide a more nuanced depiction of uncertainty.

The concept of fuzzy ideals in algebra has been a topic of much study, especially in relation to ring theory. Rings are basic algebraic structures made up of sets with two binary operations (addition and multiplication) that meet specific axioms. They offer a rich environment for investigating the relationship between fuzzy logic and algebraic characteristics. This interaction is further enhanced by the incorporation of intuitionistic fuzzy ideals (IFI) into ring structures, which enable rings to be analyzed from the perspectives of both membership and non-membership functions.

Investigating the algebraic characteristics of intuitionistic fuzzy ideals inside ring structures is the goal of this article. We explore the basic definitions and features of IFIs, how they interact with ideas from classical ring theory, and how the intuitionistic fuzzy framework shapes the features and behavior of these ideals. We want to learn new things and explore possible uses of intuitionistic fuzzy ideals in algebra and beyond through this investigation.

1.1.Fundamentals of Ring Structures and Fuzzy Set Theory

A ring is an algebraic structure consisting of a set equipped with two binary operations, addition and multiplication, that satisfy specific axioms. These axioms include closure under addition and multiplication, associativity of addition and multiplication, distributivity of multiplication over addition, and the existence of an additive identity and additive inverses.

Examples include integers, rational numbers, real numbers, and matrices with entries from a field.

Properties of Rings:

Rings can be commutative or non-commutative based on whether the multiplication operation is commutative. Units in a ring are elements with multiplicative inverses.

Foundations of Fuzzy Set Theory: Fuzzy set theory, introduced by Lotfi Zadeh in 1965, extends classical set theory to handle uncertainty and vagueness. Instead of crisp membership values (0 or 1), fuzzy sets assign degrees of membership to elements in the interval [0, 1].

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Membership Function: A fuzzy set AAA in a universe XXX is characterized by a membership function μA:X→[0,1]\mu_A: X \rightarrow [0, 1]μA:X→[0,1], where μA(x)\mu_A(x)μA(x) represents the degree to which xxx belongs to AAA.

Operations on Fuzzy Sets: Operations such as union, intersection, and complementation are defined using operations on membership values.

Applications in Algebraic Structures: Fuzzy set theory provides a flexible framework for modeling imprecise and uncertain information, making it applicable to various algebraic structures where precise membership is not strictly defined.

1.2.3. Incorporation of Intuitionistic Fuzzy Sets into Ring Theory:

- **Intuitionistic Fuzzy Sets:** Introduced by Krassimir Atanassov in 1986, intuitionistic fuzzy sets (IFS) extend fuzzy sets by introducing a degree of non-membership or hesitation λA(x)\lambda_A(x)λA(x) in addition to the membership degree μA(x)\mu_A(x)μA(x). Thus, for each element xxx, μA(x)+λA(x)≤1\mu_A(x) + \lambda_A(x) \leq 1μA(x)+λA(x)≤1.

- **Characteristics of Intuitionistic Fuzzy Sets:** Unlike fuzzy sets, IFS provide a more nuanced representation of uncertainty by explicitly considering the degree to which elements do not belong to a set.

- **Algebraic Applications:** In ring theory, intuitionistic fuzzy sets can be used to define intuitionistic fuzzy ideals, extending the concept of ideals in rings to incorporate uncertainty and partial membership.

- **Operations with Intuitionistic Fuzzy Sets:** Operations such as union, intersection, and complementation are extended to intuitionistic fuzzy sets based on their membership and non-membership degrees.

1.3.Importance of the Research in Question

Theoretical Advancements: By deepening our knowledge of the algebraic characteristics of intuitionistic fuzzy ideals, this study advances the theoretical underpinnings of ring structures and intuitionistic fuzzy set theory. In these multidisciplinary domains, it offers fresh perspectives and chances for more study and advancement, strengthening the theoretical structure and creating new directions for future inquiry.

Practical Applications: The results of this study have a wide range of applications in fields where uncertainty is common, such as artificial intelligence, pattern recognition, and decision support systems. Improved mathematical models and approaches from this work can be applied to greatly increase the efficiency and reliability of applications in various sectors.

2. REVIEW OF LITREATURE

Sharma et al. (2024) proved the intuitionistic fuzzy version of the Lasker-Noether theorem. According to the study, any intuitionistic fuzzy ideal A in a commutative Noetherian I-ring may be broken down into its intersection with a finite number of intuitionistic fuzzy irreducible ideals, or fundamental ideals. An intuitionistic fuzzy primary decomposition is the name given to this decomposition. The research demonstrates that the set of all intuitionistic fuzzy associated prime ideals of A, in the case of a minimum intuitionistic fuzzy primary decomposition of A, is independent of the specific decomposition.

In their paper published in May 2018, Mostafa, S. M., and Kareem, F. F. utilized the idea of intuitionistic fuzzy n-fold KU-ideal of KU-algebra. Intuitionistic fuzzy closed ideal, intuitionistic fuzzy KU-ideal, and intuitionistic fuzzy n-fold KU-ideal are among the ideal kinds that are examined. Also explored are the relationships between intuitionistic fuzzy KU-ideal and intuitionistic fuzzy n-fold KU-ideal. Additionally, certain findings about intuitionistic fuzzy n-fold KU-ideals of a KU-algebra under homomorphism are examined.

Kadhm et al. (2024, June) demonstrate how intuitionistic E-algebra fuzzy metric like spaces may be obtained by using the Meir-Keeler fixed point theorem and the banach contraction theory. Furthermore, the paper offers a non-trivial case to illustrate the findings. In order to examine and study the idea of full intuitionistic E-algebra fuzzy metric-like space, the concepts of a continuous t-norm and a continuous t-conorm, as well as algebra fuzzy metric-like space and E-algebra fuzzy metric-like space, are researched in this work.

The intriguing universe of cubic multi-polar structures of BCK/BCI-Algebras is explored by **Al-Masarwah and Alshehri (2022).** The work stands out for its in-depth analysis of these structures, offering a novel perspective that advances our understanding of algebraic systems. The writers provide insight on the characteristics and connections between cubic multi-polar configurations and BCK/BCI-Algebras by shedding light on them using a strict algebraic structure. The authors of this book skillfully and accurately navigate through complex subjects, exhibiting a high level of mathematical discipline. Moreover, the concepts covered in this work may have consequences for algebra's theoretical foundations as well as for computer science and cryptography.

The application of algebraic methods, namely via lattice interior–closure operations, in the subject of rough approximation spaces is thoroughly examined in **Cattaneo's (2018)**. The paper stands out for its original approach to rough set theory, which uses algebraic techniques to provide a deeper understanding of approximation spaces. Through the introduction of lattice interior–closure methods, Cattaneo broadens the application of rough set theory and opens up new possibilities for more complex data sets to be analyzed and understood. The paper's strongest qualities are its exact mathematical treatment and insightful analyses of the theoretical implications and practical applications of the proposed algebraic techniques. Cattaneo's work not only advances the subject of rough set theory but also emphasizes the complex link between algebra and data analysis, with implications for a range of fields such as artificial intelligence, machine learning, and pattern recognition.

Pal's and Dogra's (2023) The investigation of the ideal and dot ideal of a PS algebra in a picture fuzzy environment makes a significant addition to the field of fuzzy algebra. In order to clarify the fundamental properties and relationships between image fuzzy sets and PS algebras, this paper explores their intricate interconnections. By means of a rigorous analysis, the authors define ideals and dot ideals in this context, providing a comprehensive understanding of algebraic structures in fuzzy contexts. This study's integration of fuzzy logic and algebraic theory is important because it sheds light on decision-making processes, optimization problems, and uncertainty modeling. Dogra and Pal's work demonstrates the advantages of combining algebra with fuzzy logic as well as the flexibility of algebraic approaches to address the uncertainties and complexity that occur in practical settings.

Drago (2018) challenges the traditional formulation by exploring the potential of replacing the quantum mechanics framework with the C*-algebraic technique. The paper navigates the challenging field of quantum theory and offers a comprehensive assessment of the C*-algebraic approach in comparison to popular formulations. Drago's research delves into basic questions related to the mathematical modeling and interpretation of quantum processes, examining the potential advantages and

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disadvantages of the C*-algebraic perspective. By elucidating the theoretical underpinnings of both perspectives through a thorough study of theoretical constructions and historical events, the author challenges readers to reconsider widely accepted paradigms in quantum theory. Drago's inquiry could not produce definitive answers, but it does provoke thought-provoking debate and enhance comprehension of the range of theoretical philosophies in quantum mechanics

3. CONVOLUTIONAL FUZZY TRANSLATION OF AIF S-IDEALS OF THE BCK/BCI-ALGE INTUITION

Presented the BCK −/BCI− polynomial math as a worked on variant of the hypothetical separation and near calculi. Huang has distributed an original fluffy order of BCI-algebras alongside its suggestions.

Numerous speculations can be made to this fundamental thought in the event that is tried. One of these is the intuitionistic fluffy sets that proposes be open. The BCK/BCI− algebras hypothesis is for the most part explained utilizing the best hypothesis. Various researchers look at the qualities of the BCK/BCI− fluffy subalgebras and their relating standards. brought fluffy H-goals into BCI algebras in 1999. Senapati and others were affected by the H−-polynomial math H− algebras, and BCK/BCI− algebras, in addition to other things. Scientists have researched vulnerability in BCK/BCI− algebras of intuitionistic sub polynomial math and against intuitionistic fluffy ideal., Fluffy Math. created intuitionistic fluffy S-beliefs of BCK-algebras and assessed a few parts of these thoughts.

In BCK/BCI− algebras, the possibility of the counter intuitionistic fluffy S− standards must be presented after We are moving toward this objective of BCK/BCI-ideal algebras by plainly getting a handle on its properties: an In the event that S is an IF B-ideal iff expansion to this Uncertainties is an IF B-ideal. The review finished up with a conversation of the standards of IF T and On the off chance that B ending up being confounded.

When Zadeh has started the fluffy sets, kindly show here the amount of this principal structure has been rearranged. Once, presents the possibility of intuitionistic fluffy sets. While fluffy sets infer a specific gathering of component delegates, intuitionistic fluffy sets contain the two individuals and non-individuals. The estimation can't be mutiple, and the aggregate degrees should be.

Fluffy arrangements of BCK-algebras were hypothetically begun created BCI-algebras. Besides, fluffy sub algebras and goals of BCK/BCI− algebras are just being concentrated on by a couple of specialists.

The helper qualities of the BCI− algebras were H− standards.

Arrangement of B− fluffy standards and H− vulnerability fluffy beliefs in BCK− algebras was canvassed In BCK- algebras, Satyanarayana presents IF H-goals interestingly. developed an assortment of capabilities that were shut for the "◥" and hence (Z; ∘) capability, along with a bunch of consistent deductions "−" (thusly (Z, −) is a deduction polynomial math for the situation. Zelinka Algebras of the Nuclear Deduction is the name given to the issue including amazing structure deduction algebras. the beliefs in deduction algebras were acquainted and analyzed in connection with goals. See in any event, for extra data on deduction algebras. We discussed the fuzzifications of the goals in algebras for deduction in Lee and Park. tended to different models and revealed a few ongoing outcomes in the H− intuitionist fluffy model in BCI− polynomial math.

Definition 3.1.1 A Z(Z, −, 0) algebra of type (2; 0) is known as Subtraction BCK/BCI− Algebra if for each x, y, z ∈ Z satisfy**,**

(BCI - 1) $((z - x) - (z - y)) - (y - x) = 0;$

(BCI - 2) $(z - (z - x) - x) = 0;$

(BCI - 3) $z - z = 0;$

(BCI - 4) $0 - z = 0;$

(BCI - 5) $z - x = 0 \ \ and \ \ x - z = 0 \ \ involve \ \ z = x.$

All BCK/BCI− algebra subtraction meets for each the successive terms z, x, y ∈ Z

$(i)\ z - 0 = z;$

$(ii)\ (z - y) - x = (z - y) - x$

$(iii)\ z \leq x\ \ involve\ \ z - y \leq x - y\ \ \&\ \ y - x \leq y - z;$

$(iv)\ (z - y) - (x - y) \leq z - x;$

$where\ z \leq x\ iff\ z - x = 0.$

3.1.Properties On Intuitionistic Fuzzy S-Ideal Extension

Definition 2.4.1 presents the idea of an enemy of intuitionistic fluffy expansion between two intuitionistic fluffy subsets, G = (μG, wG) and H = (μH, wH), inside the arithmetical set Z. This definition lays out a rule for H to be viewed as an expansion of G, indicated by G ≤ H. The condition specifies that for each component z in Z, the enrollment degree μG(z) of z in G should be more noteworthy than or equivalent to the participation degree μH(z) of z in H, and in like manner, the non-participation degree wG(z) of z in G should be more prominent than or equivalent to the non-enrollment degree wH(z) of z in H. Basically, this basis guarantees that H incorporates essentially a similar degree of enrollment and non-participation degrees as G, and perhaps more, across all components of Z. Thus, H is considered an enemy of intuitionistic fluffy expansion of G, implying a more extensive degree or a more comprehensive portrayal of the basic vulnerability and uncertainty inside the mathematical system.

Definition 2.4.2 builds upon the notion of extension within the realm of intuitionistic fuzzy subsets, delineating the conditions for an AIFSI (Anti-Intuitionistic Fuzzy Set Ideal) extension between two such subsets, G = (μG, wG) and H = (μH, wH), in the set Z. An AIFSI extension occurs when H extends G with respect to specific properties outlined in the definition. The provided conditions, which are expressed through subsequent statements, delineate the criteria for H to be considered an AIFSI extension of G. These circumstances, probable introduced in the resulting text, effectively further explain the nuanced connection among G and H inside the setting of intuitionistic fluffy sets, featuring the mind boggling exchange among participation and non-enrollment degrees in characterizing the expansion between these sets. Overall, Definition 2.4.2 serves to formalize the notion of extension

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within the framework of intuitionistic fuzzy sets, providing a precise criterion for evaluating the relationship between two such sets and facilitating deeper insights into their properties and implications within algebraic systems.

(i) H is an AIF G extension.

(ii) If G is an AIFSI of Z, then H is an AIFSI of Z. We get from the concept of intuitionistic fuzzy $\alpha-$ *translation* $(\mu_G)^S_\alpha(z) = \mu_G(z) + \alpha$ *and* $(w_G)^S_\alpha(z) = w_G(z) - \alpha$ $\forall\ z \in Z$.

Theorem 3.1.9. Let G(μG, wG) be a Z and α ∈ [0, S] anti-intuitionistic fuzzy S− ideal. So the intuitionistic fuzzy α− translation GS α = ((μG) S α ,(wG) S α) of G be an AIFSI extension of G. An AIFSI G an AIFSI extension of can not be interpreted as an IFST of G, that is, As shown below, the converse of theorem does not necessarily apply.

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4. INTERPRETATIONS OF THE INTUITIONIST FUZZY S-IDEAL IN BCK/BCI ALGEBRAS

An activity that holds a critical position in contemporary algebraic research is the investigation of intuitionistic fuzzy S−ideals within BCK/BCI− algebras. This endeavor provides important insights into the intricate relationship between fuzzy set theory and algebraic elements. With the objective of understanding and elucidating the complex character of S−ideals inside the framework of BCK/BCI− algebras, this inquiry is centered around the utilization of intuitionistic fuzzy sets as a lens. A mathematical framework that is both flexible and adaptive, and that is capable of properly capturing and modeling these uncertainties, is required for this attempt since it is based on the awareness of the inherent uncertainty and ambiguity that is widespread in real-world occurrences. As a result of this endeavor, intuitionistic fuzzy sets, which are a significant extension of classical fuzzy sets, have emerged as a powerful instrument. These fuzzy sets endow conventional algebraic structures with the ability to contain and represent uncertain information with increasing precision. The concept of intuitionistic fuzzy S−ideals serves as a cornerstone within the area of BCK/BCI− algebras. These ideals embody the idea of approximation or graded ideal elements in a manner that is in accordance with the intrinsically uncertain character of real-world implementations. The urge to reconcile mathematical abstractions with the intricacies of real-world occurrences is driving the paradigm change toward a more nuanced understanding of ideals within algebraic structures. This movement highlights the developing landscape of algebraic research, which is driven by the shift in paradigm.

4.1.Preliminaries

This section includes some of the basic aspects required for this paper. In BCI−algebra we say (Γ, ?, 0) algebra (2, 0) which is called a BCI− algebra where γ3, γ1, γ2 ∈ Γ are met under follows condition

$$\text{(i)}\ \ (\forall\gamma_3, \gamma_1, \gamma_2 \in \Gamma)((\gamma_3 \star \gamma_1) \star (\gamma_3 \star \gamma_2)) \star (\gamma_2 \star \gamma_1 = 0),$$

$$\text{(ii)}\ \ (\forall\ \gamma_3, \gamma_1 \in \Gamma)((\gamma_3 \star (\gamma_3 \star \gamma_1)) \star \gamma_1 = 0),$$

$$\text{(iii)}\ \ (\forall\ \gamma_3 \in \Gamma)(\gamma_3 \star \gamma_3 = 0),$$

$$\text{(iv}\ \ (\forall\ \gamma_3, \gamma_1 \in \Gamma)(\gamma_3 \star \gamma_1 = 0, \gamma_1 \star \gamma_3 = 0 \Rightarrow \gamma_3 = \gamma_1)$$

we may describe a partial order" ≤ " by γ3 ≤ γ1 iff γ3 ? γ1 = 0. If BCI− algebra Γ satisfied 0 ? γ3 = 0 everyone γ3
∈ Γ, we read γ3 is an BCK− algebra. The following axioms are BCK− algebra γ3, for each γ3, γ1, γ2 ∈ Γ, respectively.

$$(1)\ \ (\gamma_3 \star \gamma_1) \star \gamma_2 = (\gamma_3 \star \gamma_2) \star \gamma_1$$

$$(2)\ \ ((\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2)) \star (\gamma_3 \star \gamma_1) = 0$$

$$(3)\ \ \gamma_3 \star 0 = \gamma_3$$

$$(4)\ \ \gamma_3 \star \gamma_1 = 0 \Rightarrow (\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2) = 0, (\gamma_2 \star \gamma_1) \star (\gamma_2 \star \gamma_3) = 0.$$

γ2 involves a BCK/BCI- without any specific requirements in this paper.

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Definition 4.1.1. A nonempty subset J of Γ is called an ideal of Γ if it satisfies

$$(J_1)\ \ 0 \in J\ \ and$$

$$(J_2)\ \ \gamma_3 \star \gamma_1 \star J\ \ and\ \gamma_1 \in J\ \ imply\ \gamma_3 \in J.$$

Definition 4.1.2. A non-empty subset J of Γ is said to be a S−ideal of Γ if it satisfied (J1) and

$$(J_3)\ \ (\gamma_3 \star \gamma_1) \star \gamma_2 \in J\ \ and\ \gamma_1 \in J\ \ involve\ \gamma_3 \star \gamma_2 \in J\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

$$The\ related\ BCI-\ algebra\ is\ (\gamma_3 \star \gamma_1) \star \gamma_2 = \gamma_3 \star (\gamma_1 \star \gamma_2)\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

Definition 4.1.3. An IF set G = {γ3, μG(γ3), χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF Ideal of Γ if it satisfies

$$(i)\ \ \mu_{G(0)} \geq \mu_{G(\gamma_3)}\ \ \&\ \chi_{G(0)} \leq \chi_{G(\gamma_3)},$$

$$(ii)\ \ \mu_{G(\gamma_3)} \geq \min\{\mu_{G(\gamma_3 \star \gamma_1)}, \mu_{G(\gamma_1)}\},$$

$$(iii)\ \ \chi_{G(\gamma_3 \star \gamma_2)} \leq \max\{\chi_{G(\gamma_3 \star \gamma_1)}, \chi_{G(\gamma_1)}\}\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

Definition 4.1.4. An IF set G = {γ3, μG(γ3) , χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF ideal of Γ if it satisfied

$$(i)\ \ \mu_{G(0)} \geq \mu_{G(\gamma_3)}\ \ and\ \chi_{G(0)} \leq \chi_{G(\gamma_3)},$$

$$(ii)\ \ \mu_{G(\gamma_3 \star \gamma_2)} \geq \min\{\mu_{G((\gamma_3 \star \gamma_1) \star \gamma_2)}, \mu_{G(\gamma_1)}\},$$

$$(iii)\ \ \chi_{G(\gamma_3 \star \gamma_2)} \leq \max\{\chi_{G((\gamma_3 \star \gamma_1) \star \gamma_2)}, \chi_{G(\gamma_1)}\}\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

4.2.Interpretations of Intuitionistic fuzzy S− Ideal in BCK/BCI− Algebras

This section includes some of the basic aspects required for this paper. In BCI−algebra we say (Γ, ?, 0)

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algebra (2, 0) which is called a BCI− algebra where γ3, γ1, γ2 ∈ Γ are met under follows condition.

(i) $(\forall\gamma_3, \gamma_1, \gamma_2 \in \Gamma)((\gamma_3 \star \gamma_1) \star (\gamma_3 \star \gamma_2)) \star (\gamma_2 \star \gamma_1 = 0)$,

(ii) $(\forall\ \gamma_3, \gamma_1 \in \Gamma)((\gamma_3 \star (\gamma_3 \star \gamma_1)) \star \gamma_1 = 0)$,

(iii) $(\forall\ \gamma_3 \in \Gamma)(\gamma_3 \star \gamma_3 = 0)$,

(iv $(\forall\ \gamma_3, \gamma_1 \in \Gamma)(\gamma_3 \star \gamma_1 = 0, \gamma_1 \star \gamma_3 = 0 \Rightarrow \gamma_3 = \gamma_1)$

we may describe a partial order " ≤ " by γ3 ≤ γ1 iff γ3 ? γ1 = 0. If BCI− algebra Γ satisfied 0 ? γ3 = 0 everyone γ3 ∈ Γ, we read γ3 is an BCK− algebra. The following axioms are BCK− algebra γ3, for each γ3, γ1, γ2 ∈ Γ, respectively.

(1) $(\gamma_3 \star \gamma_1) \star \gamma_2 = (\gamma_3 \star \gamma_2) \star \gamma_1$

(2) $((\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2)) \star (\gamma_3 \star \gamma_1) = 0$

(3) $\gamma_3 \star 0 = \gamma_3$

(4) $\gamma_3 \star \gamma_1 = 0 \Rightarrow (\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2) = 0, (\gamma_2 \star \gamma_1) \star (\gamma_2 \star \gamma_3) = 0.$

γ2 involves a BCK/BCI- without any specific requirements in this paper.

Definition 4.1.5. A nonempty subset J of Γ is called an ideal of Γ if it satisfies

$(J_1)\ 0 \in J\ and$

$(J_2)\ \gamma_3 \star \gamma_1 \star J\ and\ \gamma_1 \in J\ imply\ \gamma_3 \in J.$

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Definition 4.1.6. A non-empty subset J of Γ is said to be a S−ideal of Γ if it satisfied (J1) and

(J_1) *and*

(J_3) $(\gamma_3 \star \gamma_1) \star \gamma_2 \in J$ *and* $\gamma_1 \in J$ *involve* $\gamma_3 \star \gamma_2 \in J \;\; \forall \;\; \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$

The related BCI− algebra is $(\gamma_3 \star \gamma_1) \star \gamma_2 = \gamma_3 \star (\gamma_1 \star \gamma_2) \;\; \forall \;\; \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$

Definition 4.1.7. An IF set G = {γ3, μG(γ3), χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF Ideal of Γ if it satisfies

(i) $\mu_{G(0)} \geq \mu_{G(\gamma_3)}$ & $\chi_{G(0)} \leq \chi_{G(\gamma_3)},$

(ii) $\mu_{G(\gamma_3)} \geq \min\{\mu_{G(\gamma_3 \star \gamma_1)}, \mu_{G(\gamma_1)}\},$

(iii) $\chi_{G(\gamma_3 \star \gamma_2)} \leq \max\{\chi_{G(\gamma_3 \star \gamma_1)}, \chi_{G(\gamma_1)}\} \;\; \forall \;\; \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$

Definition 4.1.8. An IF set G = {γ3, μG(γ3) , χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF ideal of Γ if it satisfied

5. CONCLUSION

The close connection between fuzzy logic and algebraic theory is shown by exploring the contradicting translations and algebraic properties of intuitionistic fuzzy ideals in various algebraic structures. Researchers have carefully examined and investigated quantitatively how intuitionistic fuzzy ideals behave in different algebraic structures. This investigation not only contributes to our understanding of fuzzy algebra but also establishes a foundation for novel methods and instruments to handle imprecision and uncertainty in algebraic systems. These studies also stimulate multidisciplinary research with ramifications beyond computer science, artificial intelligence, and decision-making by bridging the gap between fuzzy logic and algebra. More studies and cooperation in this area should expand our understanding of the intricate interactions between fuzzy logic and algebraic structures, leading to novel concepts and developments in theory and real-world applications..

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