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SOME OPERATIONS ON INTERVAL VALUED INTUITIONISTIC ANTI FUZZY PRIMARY IDEALS OVER $P_{\alpha,\beta}$ AND $Q_{\alpha,\beta}$

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ABSTRACT

In this paper, we introduce the interval valued intuitionistic anti fuzzy primary ideal (IVIAFPI) and its basic operations. Also we establish some of their properties.

Keywords: *Interval valued fuzzy subset, interval valued fuzzy primary ideal, interval valued intuitionistic fuzzy subset, interval valued intuitionistic fuzzy primary ideal, interval valued intuitionistic anti fuzzy primary ideal.*

1 INTRODUCTION

The concept of intuitionistic fuzzy set (IFS) was proposed by K.T.Atanssov[1] as an extension of fuzzy sets introduced by L.A.Zadeh[8]. A generalization of the notion of fuzzy set so called Interval valued fuzzy set (IVFS) were proposed by some researchers [6,7]. Atanassov, K.T, & G.Gargov were introduced the theory of Interval valued intuitionistic fuzzy set and established its operators and their properties [3, 4]. Murugalingam.K and Arjunan.K defined an interval valued intuitionistic fuzzy subsemirings of a semiring [5].

The authors further introduced the theory so called interval valued intuitionistic anti fuzzy primary ideal and established its basic operations. The rest of the paper is designed as follows: In section 2, we give some basic definitions. In section 3, we defined the interval valued intuitionistic anti fuzzy primary ideal. Also we establish some operations among the theorems. This paper is concluded in section 4.

2. PREMILINARIES

2.1 Definition [3, 5]: Let X be any nonempty set. A mapping $M : X \to D[0,1]$ is called an interval valued fuzzy subset (briefly, IVFS) of X, where $D[0,1]$ denotes the family of all closed sub intervals of $[0,1]$ and $M(x) = [M^-(x), M^+(x)]$, for all x in X, where M^- and M^+ are fuzzy subsets of X such that $M^-(x) \le M^+(x)$, for all x in X. Thus $M^-(x)$ is an interval and not a number from the interval $[0,1]$ as in the case of fuzzy subset. Note that $[0] = [0,0]$ and $[1] = [1,1]$.

2.2 Definition [3, 5]: An interval valued intuitionistic fuzzy subset (IVIFS) A in X is defined as an object of the form $A = \{< x, M_A(x), N_A(x) > / x \text{ in } X\}$, where $M_A : X \to D[0,1]$ and $N_A : X \to D[0,1]$ define the degree of membership and the degree of non-membership of the element $x \in X$ respectively and for every $x \in X$ satisfying $M^+{}_A(x) + N^+{}_A(x) \le 1$.

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2.3 Definition: An interval valued intuitionistic fuzzy subset A of R is said to be an interval valued intuitionistic fuzzy primary ideal of R if its satisfies the following axioms :

$(i)\quad M_A(xy) \le r\max\left\{M_A\left(x^m\right)\right\}$

$(ii)\quad N_A(xy) \ge r\min\left\{N_A\left(x^m\right)\right\}$

For all x and y in R.

2.4 Definition: An interval valued intuitionistic anti fuzzy subset A of R is said to be an interval valued intuitionistic anti fuzzy primary ideal of R if its satisfies the following axioms :

$(i)\quad M_A(xy) \ge r\min\left\{M_A\left(x^m\right)\right\}$

$(ii)\quad N_A(xy) \le r\max\left\{N_A\left(x^m\right)\right\}$

For all x and y in R.

2.5 DEFINITION [3, 5]

Let A be an interval valued intuitionistic fuzzy subset of X. Then the following operations as

$$(i)\quad P_{\alpha,\beta}(A) = \left\{\begin{array}{l}\langle x, r\max\{\alpha, M_A(x)\}, r\min\{\beta, N_A(x)\}\rangle / \\ for\ all\ x \in X\ and\ \alpha,\beta\ in\ D[0,1]\end{array}\right\}$$

$$(ii)\quad Q_{\alpha,\beta}(A) = \left\{\begin{array}{l}\langle x, r\min\{\alpha, M_A(x)\}, r\max\{\beta, N_A(x)\}\rangle / \\ for\ all\ x \in X\ and\ \alpha,\beta\ in\ D[0,1]\end{array}\right\}$$

$$(iii)\ A \cup B = \left\{\begin{array}{l}\left[\begin{array}{l}x, \max\left(M_A^-(x), M_B^+(x)\right), \max\left(M_A^-(x), M_B^+(x)\right), \\ \min\left(N_A^-(x), N_B^+(x)\right), \min\left(N_A^-(x), N_B^+(x)\right)\end{array}\right] \\ \mid x \in X\end{array}\right\}$$

$$(iv)\ A \cap B = \left\{\begin{array}{l}\left[\begin{array}{l}x, \min\left(M_A^-(x), M_B^+(x)\right), \min\left(M_A^-(x), M_B^+(x)\right), \\ \max\left(N_A^-(x), N_B^+(x)\right), \max\left(N_A^-(x), N_B^+(x)\right)\end{array}\right] \\ \mid x \in X\end{array}\right\}$$

$$(v)\quad \overline{A} = \left\{\langle x, \left[N_A^-(x), N_A^+(x)\right], \left[M_A^-(x), M_A^+(x)\right]\rangle \mid x \in X\right\}$$

$$(vi)\quad I(A) = \left\{x / r\min\left(M_A(x)\right), r\max\left(N_A(x)\right) / x \in E\right\}$$

$$(vii)\quad C(A) = \left\{x / r\max\left(M_A(x)\right), r\min\left(N_A(x)\right) / x \in E\right\}$$

3. SOME PROPERTIES

3.1 Theorem [by definition 2.4, 2.5(i, iv)]: If A and B is an interval valued intuitionistic anti fuzzy primary ideal of R then $P_{\alpha,\beta}(A \cap B) = P_{\alpha,\beta}(A) \cap P_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha,\beta \in [0,1]$ and $\alpha + \beta \le 1$.

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A = \left\{\langle x, M_A(x), N_A(x)\rangle / x \in R\right\}$ for some $m \in z^+$ and for every $x, y \in R$

If B is an interval valued intuitionistic anti fuzzy primary ideal of R then $B = \left\{\langle x, M_B(x), N_B(x)\rangle / x \in R\right\}$ for some $m \in z^+$ and for every $x, y \in R$

Consider $x, y \in R$ then $x, y \in A \cap B$

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Consider

$$
\begin{aligned}
M_{P_{\alpha,\beta}(A\cap B)}(xy) &= r\max\{\alpha, M_{A\cap B}(xy)\}\\
&= r\max\left(\alpha, r\min\left[M_A(xy), M_B(xy)\right]\right)\\
&\geq r\min\left(\alpha, r\max\left[r\min\left\{M_A(x^m), M_B(x^m)\right\}\right]\right)\\
&= r\min\left(r\min\left[r\max\left\{\alpha, M_A(x^m)\right\}, r\max\left\{\alpha, M_B(x^m)\right\}\right]\right)\\
&= r\min\left(r\min\left[M_{P_{\alpha,\beta}(A)}(x^m), M_{P_{\alpha,\beta}(B)}(x^m)\right]\right)\\
&= r\min\left[M_{P_{\alpha,\beta}(A)}(x^m)\cap M_{P_{\alpha,\beta}(B)}(x^m)\right]
\end{aligned}
$$

Therefore $M_{p_{\alpha,\beta}(A\cap B)}(xy) \geq r\min M_{P_{\alpha,\beta}(A\cap B)}(x^m)$

Consider

$$
\begin{aligned}
N_{P_{\alpha,\beta}(A\cap B)}(xy) &= r\min\{\beta, N_{A\cap B}(xy)\}\\
&= r\min\left(\beta, r\max\left[N_A(xy), N_B(xy)\right]\right)\\
&\leq r\max\left(\beta, r\min\left[r\max\left\{N_A(x^m), N_B(x^m)\right\}\right]\right)\\
&= r\max\left(r\max\left[r\min\left\{\beta, N_A(x^m)\right\}, r\min\left\{\beta, N_B(x^m)\right\}\right]\right)\\
&= r\max\left(r\max\left[N_{P_{\alpha,\beta}(A)}(x^m), N_{P_{\alpha,\beta}(B)}(x^m)\right]\right)\\
&= r\max\left[N_{P_{\alpha,\beta}(A)}(x^m)\cap N_{P_{\alpha,\beta}(B)}(x^m)\right]
\end{aligned}
$$

Therefore $N_{P_{\alpha,\beta}(A\cap B)}(xy) \leq r\max N_{P_{\alpha,\beta}(A\cap B)}(x^m)$

Therefore $P_{\alpha,\beta}(A\cap B) = P_{\alpha,\beta}(A)\cap P_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

3.2 Theorem [by definition 2.4, 2.5(i, iii)]: If A and B is an interval valued intuitionistic anti fuzzy primary ideal of R then $P_{\alpha,\beta}(A\cup B) = P_{\alpha,\beta}(A)\cup P_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha,\beta\in[0,1]$ and $\alpha+\beta\leq 1$

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A = \left\{\langle x, M_A(x), N_A(x)\rangle / x\in R\right\}$ for some $m\in z^+$ and for every $x, y\in R$

If B is an interval valued intuitionistic anti fuzzy primary ideal of R then $B = \left\{\langle x, M_B(x), N_B(x)\rangle / x\in R\right\}$ for some $m\in z^+$ and for every $x, y\in R$

Consider $x, y\in R$ then $x, y\in A\cup B$

Consider

$$
\begin{aligned}
M_{P_{\alpha,\beta}(A\cup B)}(xy) &= r\max\{\alpha, M_{A\cup B}(xy)\}\\
&= r\max\left(\alpha, r\max\left[M_A(xy), M_B(xy)\right]\right)\\
&\geq r\max\left(\alpha, r\max\left[r\min\left\{M_A(x^m), M_B(x^m)\right\}\right]\right)
\end{aligned}
$$

$$= r\min\left(r\max\left[r\max\left\{\alpha, M_A\left(x^m\right)\right\}, r\max\left\{\alpha, M_B\left(x^m\right)\right\}\right]\right)$$
$$= r\min\left(r\max\left[M_{P_{\alpha,\beta}(A)}\left(x^m\right), M_{P_{\alpha,\beta}(B)}\left(x^m\right)\right]\right)$$
$$= r\min\left[M_{P_{\alpha,\beta}(A)}\left(x^m\right)\cup M_{P_{\alpha,\beta}(B)}\left(x^m\right)\right]$$

Therefore $M_{P_{\alpha,\beta}(A\cup B)}(xy) \geq r\min M_{P_{\alpha,\beta}(A\cup B)}\left(x^m\right)$

Consider

$$N_{P_{\alpha,\beta}(A\cup B)}(xy) = r\min\left\{\beta, N_{A\cup B}(xy)\right\}$$
$$= r\min\left(\beta, r\min\left[N_A(xy), N_B(xy)\right]\right)$$
$$\leq r\min\left(\beta, r\min\left[r\max\left\{N_A\left(x^m\right), N_B\left(x^m\right)\right\}\right]\right)$$
$$= r\max\left(r\min\left[r\min\left\{\beta, N_A\left(x^m\right)\right\}, r\min\left\{\beta, N_B\left(x^m\right)\right\}\right]\right)$$
$$= r\max\left(r\min\left[N_{P_{\alpha,\beta}(A)}\left(x^m\right), N_{P_{\alpha,\beta}(B)}\left(x^m\right)\right]\right)$$
$$= r\max\left[N_{P_{\alpha,\beta}(A)}\left(x^m\right)\cup N_{P_{\alpha,\beta}(B)}\left(x^m\right)\right]$$

Therefore $N_{P_{\alpha,\beta}(A\cup B)}(xy) \leq r\max N_{P_{\alpha,\beta}(A\cup B)}\left(x^m\right)$

Therefore $P_{\alpha,\beta}(A\cup B) = P_{\alpha,\beta}(A)\cup P_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

3.3 Theorem [by definition 2.4, 2.5(ii, iv)]: If A and B is an interval valued intuitionistic anti fuzzy primary ideal of R then $Q_{\alpha,\beta}(A\cap B) = Q_{\alpha,\beta}(A)\cap Q_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha,\beta\in[0,1]$ and $\alpha+\beta\leq 1$.

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A = \left\{\langle x, M_A(x), N_A(x)\rangle / x\in R\right\}$ for some $m\in z^+$ and for every $x, y\in R$

If B is an interval valued intuitionistic anti fuzzy primary ideal of R then $B = \left\{\langle x, M_B(x), N_B(x)\rangle / x\in R\right\}$ for some $m\in z^+$ and for every $x, y\in R$

Consider $x, y\in R$ then $x, y\in A\cap B$

Consider

$$M_{Q_{\alpha,\beta}(A\cap B)}(xy) = r\min\left\{\alpha, M_{A\cap B}(xy)\right\}$$
$$= r\min\left(\alpha, r\min\left[M_A(xy), M_B(xy)\right]\right)$$
$$\geq r\min\left(\alpha, r\min\left[r\min\left\{M_A\left(x^m\right), M_B\left(x^m\right)\right\}\right]\right)$$
$$= r\min\left(r\min\left[r\min\left\{\alpha, M_A\left(x^m\right)\right\}, r\min\left\{\alpha, M_B\left(x^m\right)\right\}\right]\right)$$
$$= r\min\left(r\min\left[M_{Q_{\alpha,\beta}(A)}\left(x^m\right), M_{Q_{\alpha,\beta}(B)}\left(x^m\right)\right]\right)$$
$$= r\min\left[M_{Q_{\alpha,\beta}(A)}\left(x^m\right)\cap M_{Q_{\alpha,\beta}(B)}\left(x^m\right)\right]$$

Therefore $M_{Q_{\alpha,\beta}(A\cap B)}(xy) \geq r\min M_{Q_{\alpha,\beta}(A\cap B)}\left(x^m\right)$

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Consider

$$\begin{aligned}N_{Q_{\alpha,\beta}(A\cap B)}(xy) &= r\max\{\beta, N_{A\cap B}(xy)\}\\ &= r\max\left(\beta, r\max\left[N_A(xy), N_B(xy)\right]\right)\\ &\le r\max\left(\beta, r\max\left[r\max\left\{N_A(x^m), N_B(x^m)\right\}\right]\right)\\ &= r\max\left(r\max\left[r\max\left\{\beta, N_A(x^m)\right\}, r\max\left\{\beta, N_B(x^m)\right\}\right]\right)\\ &= r\max\left(r\max\left[N_{Q_{\alpha,\beta}(A)}(x^m), N_{Q_{\alpha,\beta}(B)}(x^m)\right]\right)\\ &= r\max\left[N_{Q_{\alpha,\beta}(A)}(x^m)\cap N_{Q_{\alpha,\beta}(B)}(x^m)\right]\end{aligned}$$

Therefore $N_{Q_{\alpha,\beta}(A\cap B)}(xy) \le r\max N_{Q_{\alpha,\beta}(A\cap B)}(x^m)$

Therefore $Q_{\alpha,\beta}(A\cap B) = Q_{\alpha,\beta}(A)\cap Q_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

3.4 Theorem [by definition 2.4, 2.5(ii, iii)]: If A and B is an interval valued intuitionistic anti fuzzy primary ideal of R the $Q_{\alpha,\beta}(A\cup B) = Q_{\alpha,\beta}(A)\cup Q_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha,\beta\in[0,1]$ and $\alpha+\beta\le 1$.

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A = \{\langle x, M_A(x), N_A(x)\rangle / x\in R\}$ for some $m\in z^+$ and for every $x, y\in R$

If B is an interval valued intuitionistic anti fuzzy primary ideal of R then $B = \{\langle x, M_B(x), N_B(x)\rangle / x\in R\}$ for some $m\in z^+$ and for every $x, y\in R$

Consider $x, y\in R$ then $x, y\in A\cup B$

Consider

$$\begin{aligned}M_{Q_{\alpha,\beta}(A\cup B)}(xy) &= r\min\{\alpha, M_{A\cup B}(xy)\}\\ &= r\min\left(\alpha, r\max\left[M_A(xy), M_B(xy)\right]\right)\\ &\ge r\min\left(\alpha, r\max\left[r\min\left\{M_A(x^m), M_B(x^m)\right\}\right]\right)\\ &= r\min\left(r\max\left[r\min\left\{\alpha, M_A(x^m)\right\}, r\min\left\{\alpha, M_B(x^m)\right\}\right]\right)\\ &= r\min\left(r\max\left[M_{Q_{\alpha,\beta}(A)}(x^m), M_{Q_{\alpha,\beta}(B)}(x^m)\right]\right)\\ &= r\min\left[M_{Q_{\alpha,\beta}(A)}(x^m)\cup M_{Q_{\alpha,\beta}(B)}(x^m)\right]\end{aligned}$$

Therefore $M_{Q_{\alpha,\beta}(A\cup B)}(xy) \ge r\min M_{Q_{\alpha,\beta}(A\cup B)}(x^m)$

Consider

$$\begin{aligned}N_{Q_{\alpha,\beta}(A\cup B)}(xy) &= r\max\{\beta, N_{A\cup B}(xy)\}\\ &= r\max\left(\beta, r\min\left[N_A(xy), N_B(xy)\right]\right)\\ &\le r\max\left(\beta, r\min\left[r\max\left\{N_A(x^m), N_B(x^m)\right\}\right]\right)\end{aligned}$$

$$= r\max\left(r\min\left[r\max\left\{\beta, N_A\left(x^m\right)\right\}, r\max\left\{\beta, N_B\left(x^m\right)\right\}\right]\right)$$
$$= r\max\left(r\min\left[N_{Q_{\alpha,\beta}(A)}\left(x^m\right), N_{Q_{\alpha,\beta}(B)}\left(x^m\right)\right]\right)$$
$$= r\max\left[N_{Q_{\alpha,\beta}(A)}\left(x^m\right)\cup N_{Q_{\alpha,\beta}(B)}\left(x^m\right)\right]$$

Therefore $N_{Q_{\alpha,\beta}(A\cup B)}(xy)\le r\max N_{Q_{\alpha,\beta}(A\cup B)}\left(x^m\right)$

Therefore $Q_{\alpha,\beta}(A\cup B)=Q_{\alpha,\beta}(A)\cup Q_{\alpha,\beta}(B)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

3.5 Theorem [by definition 2.4, 2.5(i, ii, v)]: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $\overline{P_{\alpha,\beta}\left(\overline{A}\right)}=Q_{\beta,\alpha}(A)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha,\beta\in[0,1]$ and $\alpha+\beta\le 1$

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A=\left\{\langle x, M_A(x), N_A(x)\rangle / x\in R\right\}$ for some $m\in z^+$ and for every $x,y\in R$

Consider $x,y\in R$ then $x,y\in A$

Consider

$$M_{\overline{P_{\alpha,\beta}\left(\overline{A}\right)}}(xy)=r\min\left\{\beta, N_{\left(\overline{A}\right)}(xy)\right\}$$
$$= r\min\left(\beta, M_A(xy)\right)$$
$$\ge r\min\left\{\beta, r\min\left(M_A\left(x^m\right)\right)\right\}$$
$$= r\min\left(r\min\left(\beta, M_A\left(x^m\right)\right)\right)$$

Therefore $M_{\overline{P_{\alpha,\beta}\left(\overline{A}\right)}}(xy)\ge r\min M_{Q_{\beta,\alpha}(A)}\left(x^m\right)$

Consider

$$N_{\overline{P_{\alpha,\beta}\left(\overline{A}\right)}}(xy)=r\max\left\{\alpha, M_{\left(\overline{A}\right)}(xy)\right\}$$
$$= r\max\left(\alpha, N_A(xy)\right)$$
$$\le r\max\left\{\alpha, r\max\left(N_A\left(x^m\right)\right)\right\}$$
$$= r\max\left(r\max\left(\alpha, N_A\left(x^m\right)\right)\right)$$

Therefore $N_{\overline{P_{\alpha,\beta}\left(\overline{A}\right)}}(xy)\le r\max N_{Q_{\beta,\alpha}(A)}\left(x^m\right)$

Therefore $\overline{P_{\alpha,\beta}\left(\overline{A}\right)}=Q_{\beta,\alpha}(A)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

3.6 Theorem [by definition 2.4, 2.5(ii, vi)]: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $I\left(Q_{\alpha,\beta}(A)\right)=Q_{\alpha,\beta}\left(I(A)\right)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha,\beta\in[0,1]$ and $\alpha+\beta\le 1$

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A=\left\{\langle x, M_A(x), N_A(x)\rangle / x\in R\right\}$ for some $m\in z^+$ and for every $x,y\in R$

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Consider $x, y \in R$ then $x, y \in A$

Consider

$$\begin{aligned} M_{I(Q_{\alpha,\beta}(A))}(xy) &= r\min\left\{M_{Q_{\alpha,\beta}(A)}(xy)\right\} \\ &= r\min\left(r\min\left[\alpha, M_A(xy)\right]\right) \\ &\geq r\min\left(r\min\left\{\alpha, r\min\left(M_A\left(x^m\right)\right)\right\}\right) \\ &= r\min\left(r\min\left[\alpha, M_{I(A)}\left(x^m\right)\right]\right) \end{aligned}$$

Therefore $M_{I(Q_{\alpha,\beta}(A))}(xy) \geq r\min M_{Q_{\alpha,\beta}(I(A))}\left(x^m\right)$

Consider

$$\begin{aligned} N_{I(Q_{\alpha,\beta}(A))}(xy) &= r\max\left\{N_{Q_{\alpha,\beta}(A)}(xy)\right\} \\ &= r\max\left(r\max\left[\beta, N_A(xy)\right]\right) \\ &\leq r\max\left(r\max\left\{\beta, r\max\left(N_A\left(x^m\right)\right)\right\}\right) \\ &= r\max\left(r\max\left[\beta, N_{I(A)}\left(x^m\right)\right]\right) \end{aligned}$$

Therefore $N_{I(Q_{\alpha,\beta}(A))}(xy) \leq r\max N_{Q_{\alpha,\beta}(I(A))}\left(x^m\right)$

Therefore $I\left(Q_{\alpha,\beta}(A)\right) = Q_{\alpha,\beta}\left(I(A)\right)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

3.7 Theorem [by definition 2.4, 2.5(ii,vii)]: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $C\left(Q_{\alpha,\beta}(A)\right) = Q_{\alpha,\beta}\left(C(A)\right)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha, \beta \in [0,1]$ and $\alpha + \beta \leq 1$

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A = \left\{\langle x, M_A(x), N_A(x)\rangle / x \in R\right\}$ for some $m \in z^+$ and for every $x, y \in R$

Consider $x, y \in R$ then $x, y \in A$

Consider

$$\begin{aligned} M_{C(Q_{\alpha,\beta}(A))}(xy) &= r\max\left\{N_{Q_{\alpha,\beta}(A)}(xy)\right\} \\ &= r\max\left(r\min\left[\alpha, M_A(xy)\right]\right) \\ &\geq r\max\left(r\min\left\{\alpha, r\min\left(M_A\left(x^m\right)\right)\right\}\right) \\ &= r\min\left(r\min\left\{\alpha, r\max\left(M_A\left(x^m\right)\right)\right\}\right) \\ &= r\min\left(r\min\left[\alpha, M_{C(A)}\left(x^m\right)\right]\right) \end{aligned}$$

Therefore $M_{C(Q_{\alpha,\beta}(A))}(xy) \geq r\min M_{Q_{\alpha,\beta}(C(A))}\left(x^m\right)$

Consider

$$N_{C(Q_{\alpha,\beta}(A))}(xy) = r\min\left\{N_{Q_{\alpha,\beta}(A)}(xy)\right\}$$

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$$= r\min\left(r\max\left[\beta, N_A(xy)\right]\right)$$
$$\leq r\min\left(r\max\left\{\beta, r\max\left(N_A\left(x^m\right)\right)\right\}\right)$$
$$= r\max\left(r\min\left\{\beta, r\max\left(N_A\left(x^m\right)\right)\right\}\right)$$
$$= r\max\left(r\max\left\{\beta, r\min\left(N_A\left(x^m\right)\right)\right\}\right)$$
$$= r\max\left(r\max\left[\beta, N_{C(A)}\left(x^m\right)\right]\right)$$

Therefore $N_{C\left(Q_{\alpha,\beta}(A)\right)}(xy) \leq r\max N_{Q_{\alpha,\beta}(C(A))}\left(x^m\right)$

Therefore $C\left(Q_{\alpha,\beta}(A)\right) = Q_{\alpha,\beta}\left(C(A)\right)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

3.8 Theorem [by definition 2.4, 2.5(i,vi)]: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $I\left(P_{\alpha,\beta}(A)\right) = P_{\alpha,\beta}\left(I(A)\right)$ is an interval valued intuitionistic anti fuzzy primary ideal of R and for every $\alpha, \beta \in [0,1]$ and $\alpha + \beta \leq 1$

Proof: If A is an interval valued intuitionistic anti fuzzy primary ideal of R then $A = \left\{\langle x, M_A(x), N_A(x)\rangle / x \in R\right\}$ for some $m \in z^+$ and for every $x, y \in R$

Consider $x, y \in R$ then $x, y \in A$

Consider

$$M_{I\left(P_{\alpha,\beta}(A)\right)}(xy) = r\min\left\{M_{P_{\alpha,\beta}(A)}(xy)\right\}$$
$$= r\min\left(r\max\left[\alpha, M_A(xy)\right]\right)$$
$$\geq r\min\left(r\max\left\{\alpha, r\min\left(M_A\left(x^m\right)\right)\right\}\right)$$
$$= r\min\left(r\max\left(\alpha, M_{I(A)}\left(x^m\right)\right)\right)$$

Therefore $M_{I\left(P_{\alpha,\beta}(A)\right)}(xy) \geq r\min M_{P_{\alpha,\beta}(I(A))}\left(x^m\right)$

Consider

$$N_{I\left(P_{\alpha,\beta}(A)\right)}(xy) = r\max\left\{N_{P_{\alpha,\beta}(A)}(xy)\right\}$$
$$= r\max\left(r\min\left[\beta, N_A(xy)\right]\right)$$
$$\leq r\max\left(r\min\left\{\beta, r\max\left(N_A\left(x^m\right)\right)\right\}\right)$$
$$= r\max\left(r\min\left\{\beta, N_{I(A)}\left(x^m\right)\right\}\right)$$

Therefore $N_{I\left(P_{\alpha,\beta}(A)\right)}(xy) \leq r\max N_{P_{\alpha,\beta}(I(A))}\left(x^m\right)$

Therefore $I\left(P_{\alpha,\beta}(A)\right) = P_{\alpha,\beta}\left(I(A)\right)$ is an interval valued intuitionistic anti fuzzy primary ideal of R.

4. CONCLUSION

In this paper we have defined a new extension of IVIFS, namely IVIAFPI and studied the various basic operations like union, intersection and complement. We have proved the associative of union and intersection and the distributive law of one over the other the defined IVIAFPI is useful many applications of physics, computer science, control engineering, information science, coding theory etc……..

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