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An Intuitionstic Fuzzy Meet Semi L- Filter

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Abstract: In this Paper, Intuitionistic fuzzy meet semi L-filter and Intuitionistic fuzzy level meet semi L-filter are defined. Also some theorems are derived.Some examples are provided.

Key words: Fuzzy meet semi L-ideals, fuzzy meet semi L-filter, intuitionistic fuzzy meet semi L-filter, fuzzy level meet semi L-filter, intuitionistic fuzzy level meet semi L- filter.

I INTRODUCTION

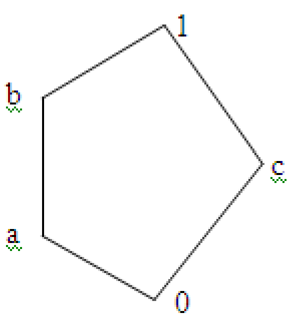
The concept of fuzzy sets was introduced in 1965 by L. A. Zadeh[3]. In that, the fuzzy group was introduced by Rosenfield[4]. M. Mullai applied the concepts of fuzzy L-filters in Lattice theory. The idea of Intuitionistic L-fuzzy semi filler was introduced by M. Maheswari and M. Palanivelrajan[1]. In paper [6], the definition of fuzzy meet semi L-filter, fuzzy level meet semi L-filter, theorems, propositions and examples are given. In this present paper intuitionistic fuzzy meet semi L-filter, intuitionistic fuzzy level meet semi L-filter are introduced. Some characterization theorem are derived. Some more results related to this topic are also established.

Definition 1.1

Let A be a fuzzy meet semilattice. A fuzzy meet subsemilattice $\mu : A \rightarrow [0,1]$ is called a fuzzy meet semi L-ideal of A if for all x , y ∈ A,
$\mu (x \Lambda y) \geq \max \{ \mu(x) , \mu(y) \}$.

Example 1.2

Let A = { 0 , a , b , 1 }. Let $\mu : A \rightarrow [0 , 1]$ is a fuzzy meet subsemilattice in A defined by $\mu (0) = 0.8$, $\mu (a) =0.5$, $\mu(b) = 0.6$, $\mu(c)=0.7$, $\mu(1) =0.4$

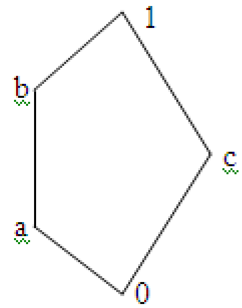


Then μ is a fuzzy meet semi L-ideal of A.

Definition 1.3 Let A be a fuzzy meet semilattice. A fuzzy meet subsemilattice $\mu : A \rightarrow [0 , 1]$ is called a fuzzy meet semi L-filter of A if for all x , y ∈ A, $\mu (x\Lambda y) \leq \min \{ \mu(x) , \mu(y) \}$.

Example 1.4

Let A = { 0 , a , b , 1 }. Let $\mu : A \rightarrow [0 , 1]$ is a fuzzy meet subsemilattice in A defined by $\mu (0) = 0.4$, $\mu (a) =0.5$, $\mu(b) = 0.6$, $\mu(c)=0.7$, $\mu(1) =0.8$.



Then μ is fuzzy meet semi L-filter of A.

Definition 1.5

Let X be a non-empty set. An intuitionistic fuzzy set A in X is an object having the form $A = \{ < x , \mu_A (x) , \nu_A (x) > / x \in A\}$ where the function $\mu_A : X \rightarrow [0 , 1]$and $\nu_A : X \rightarrow [0 , 1]$ denote the membership and non- membership function of A respectively and $0 \leq \mu_A (x) + \nu_A (x) \leq 1$, for each element x ∈ X. The intuitionistic can also be written in the form $A= < x , \mu_A (x) ,\nu_A(x) >$ or Simply $A= < \mu_A , \nu_A >$.

Example 1.6

Let X = { 4.5 , 5 , 5.5 , 6 , 6.5 , 7 , 7.5 }.
Define A = { < 4.5 , 0 ,1 >,< 5 , 0 , 1 > , < 5.5 , 0.5 , 0.5 > , < 6 , 1 , 0 > , < 6.5 , 0.5 , 0.5 > , < 7 , 0 , 1 >}.Clearly $\{ (x, \mu_A (x)) / x \in X\}$ is afuzzy set , since $0 \leq \mu_A (x) \leq 1$ for each x ∈ X. Also $\{ < x , \mu_A (x) , \nu_A (x) > / x \in X \}$ is an intuitionistic fuzzy set, since $0 \leq \mu_A (x) + \nu_A (x) \leq 1$ for each x ∈ X.

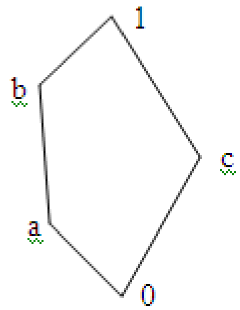
Definition 1.7

An intuitionistic fuzzy semilattice $A = < \mu_A , \nu_A >$ is called an intuitionistic fuzzy meet semi L-filter if for all x , y ∈ A ,

(i) $\mu (x \Lambda y)\leq \min \{ \mu(x) , \mu(y) \}$
(ii) $\nu(x \Lambda y)\geq \max \{ \nu (x) ,\nu(y) \}$.

Example 1.8

Let A = { 0 , a , b , 1 }. Let $\mu : A \rightarrow [0 , 1]$ and $\nu : A \rightarrow [0 , 1]$ be a fuzzy meet subsemilattices in A defined by$< \mu (0) , \nu(0) > = < 0.4 , 0.6 >$; $< \mu (a) , \nu(a) > = < 0.5 , 0.5 >$; $< \mu(b) , \nu(b) > = < 0.6 , 0.4 >$; $< \mu(c) , \nu(c) > = < 0.7, 0.3 >$; $< \mu(1) , \nu(1) > = < 0.8 , 0.2 >$.



Then A is an intuitionistic fuzzy meet semi L-filter.

Definition 1.9

Let A and B be any two an intuitionistic fuzzy meet semi L-filter of X. We define the following relations and operations:

(i)A is subset of B iff $\mu_A(x) \leq \mu_B(x)$ and $\nu_A(x) \geq \nu_B(x)$, for all $x \in X$.

(ii)A = B iff $\mu_A(x) = \mu_B(x)$ and $\nu_A(x) = \nu_B(x)$, for all $x \in X$

(iii)$\bar{A} = \{ < x , \nu_A(x) , \mu_A(x) > / x \in X \}$

(iv)$A \cap B = \{ < x , \min \{ \mu_A(x) , \mu_B(x) \}, \max \{ \nu_A(x) , \nu_B(x) \} > / x \in X \}$

(v)$A \cup B = \{ < x , \max \{ \mu_A(x) , \mu_B(x) \}, \min \{ \nu_A(x) , \nu_B(x) \} > / x \in X \}$

(vi) $\Box A = \{ < x , \mu_A(x) , 1 - \mu_A(x) > / x \in X \}$

(vii)$\Diamond A = \{ < x , \nu_A(x) , 1 - \nu_A(x) > / x \in X \}$

Theorem: 1.10

The union of two intuitionistic fuzzy meet semi L-filter is an intuitionistic fuzzy meet semi L- filter.

Proof

Let A and B be two intuitionistic fuzzy meet semi L-filters.

(ie) $\mu_A(x \wedge y) \leq \min \{ \mu_A(x) , \mu_A(y) \}$, $\nu_A(x \wedge y) \geq \max \{ \nu_A(x) , \nu_A(y) \}$

$\mu_B(x \wedge y) \leq \min \{ \mu_B(x) , \mu_B(y) \}$, $\nu_B(x \wedge y) \geq \max \{ \nu_B(x) , \nu_B(y) \}$

To prove that $A \cup B$ is an intuitionistic fuzzy meet semi L- filter

Let $C = A \cup B$

(ie) $C = \{ < x , \mu_C(x) , \nu_C(x) > / x \in L \}$ is an intuitionistic fuzzy meet semi L- filter.

If $\mu_C(x) = \max \{ \mu_A(x) , \mu_B(x) \}$

$\nu_C(x) = \max \{ \nu_A(x) , \nu_B(x) \}$

$\mu_C(x \wedge y) = \max \{ \mu_A(x \wedge y) , \mu_B(x \wedge y) \}$

$\leq \max \{ \{ \min \{ \mu_A(x) , \mu_A(y) \} , \min \{ \mu_B(x) , \mu_B(y) \} \}$

$= \min \{ \max \{ \mu_A(x) , \mu_B(x) \} , \max \{ \mu_A(y) , \mu_B(y) \} \}$

$= \min \{ \mu_C(x) , \mu_C(y) \}$

$\mu_C(x \wedge y) \leq \min \{ \mu_C(x) , \mu_C(y) \}$

$\nu_C(x \wedge y) = \max \{ \nu_A(x \wedge y) , \nu_B(x \wedge y) \}$

$\geq \max \{ \max \{ \nu_A(x) , \nu_A(y) \} , \max \{ \nu_B(x) , \nu_B(y) \} \}$

$= \max \{ \max \{ \nu_A(x) , \nu_B(x) \} , \max \{ \nu_A(y) , \nu_B(y) \} \}$

$= \max \{ \nu_C(x) , \nu_C(y) \}$

$\nu_C(x \wedge y) \geq \max \{ \nu_C(x) , \nu_C(y) \}$

Hence the union of two intuitionistic fuzzy meet semi L- filter is an intuitionistic fuzzy meet semi L- filter.

Theorem 1.11

Intersection of two intuitionistic fuzzy meet semi L-filter is an intuitionistic fuzzy meet semi L- filter.

Proof

Let A and B be two intuitionistic fuzzy meet semi L-filters.

(ie) $\mu_A(x \wedge y) \leq \min \{ \mu_A(x) , \mu_A(y) \}$, $\nu_A(x \wedge y) \geq \max \{\nu_A(x) , \nu_A(y) \}$

$\mu_B(x \wedge y) \leq \min \{ \mu_B(x) , \mu_B(y) \}$, $\nu_B(x \wedge y) \geq \max \{ \nu_B(x) , \nu_B(y) \}$

To prove that $A \cap B$ is an intuitionistic fuzzy meet semi L- filter

Let $C = A \cap B$

(ie) $C = \{ < x , \mu_C(x) , \nu_C(x) > / x \in X \}$ is an intuitionistic fuzzy meet semi L- filter.

If $\mu_C(x) = \min \{ \mu_A(x) , \mu_B(x) \}$

$\nu_C(x) = \min \{ \nu_A(x) , \nu_B(x) \}$

$\mu_C(x \wedge y) = \min \{ \mu_A(x \wedge y) , \mu_B(x \wedge y) \}$

$\mu_C(x \wedge y) = \min \{ \mu_A(x \wedge y) , \mu_B(x \wedge y) \}$

$\leq \min \{ \min \{ \mu_A(x) , \mu_A(y) \} , \min \{ \mu_B(x) , \mu_B(y) \} \}$

$= \min \{ \min \{ \mu_A(x) , \mu_B(x) \} , \min \{ \mu_A(y) , \mu_B(y) \} \}$

$= \min \{ \mu_C(x) , \mu_C(y) \}$

$\mu_C(x \wedge y) \leq \min \{ \mu_C(x) , \mu_C(y) \}$

$\nu_C(x \wedge y) = \min \{ \nu_A(x \wedge y) , \nu_B(x \wedge y) \}$

$\geq \min \{ \max \{ \nu_A(x) , \nu_A(y) \} , \max \{ \nu_B(x) , \nu_B(y) \} \}$

$= \max \{ \min \{ \nu_A(x) , \nu_B(x) \} , \min \{ \nu_A(y) , \nu_B(y) \} \}$

$= \max \{ \nu_C(x) , \nu_C(y) \}$

$\nu_C(x \wedge y) \geq \max \{ \nu_C(x) , \nu_C(y) \}$

Hence the intersection of two intuitionistic fuzzy meet semi L-filter is an intuitionistic fuzzy meet semi L- filter.

Theorem 1.12

The complement of intuitionistic fuzzy meet semi L-filter is an intuitionistic fuzzy meet semi L-ideal.

Proof

Let $A = \{ < x , \mu_A(x) , \nu_A(x) > / x \in X \}$ be an intuitionistic fuzzy meet semi L- filter.

(ie) if (i)$\mu_A(x \wedge y) \leq \min \{ \mu_A(x) , \mu_A(y) \}$

(ii)$\nu_A(x \wedge y) \geq \max \{ \nu_A(x) , \nu_A(y) \}$

To prove that compliment of A is an intuitionistic fuzzy meet semi L- ideal.

(ie) (I) $\mu_{\bar{A}}(x \wedge y) \geq \max\{ \mu_{\bar{A}}(x) , \mu_{\bar{A}}(y) \}$

(II))$\nu_{\bar{A}}(x \wedge y) \leq \min \{\nu_{\bar{A}}(x) , \nu_{\bar{A}}(y) \}$

Now the compliment of A is defined by $\bar{A} = \{ < x , \nu_A(x) , \mu_A(x) > / x \in X\}$

Here $\mu_{\bar{A}}(x) = \nu_A(x)$, $\nu_{\bar{A}}(x) = \mu_A(x)$

For (I)

$\mu_{\bar{A}}(x \wedge y) = \nu_A(x \wedge y) \geq \max \{ \nu_A(x) , \nu_A(y) \}$

$= \max \{ \mu_{\bar{A}}(x) , \mu_{\bar{A}}(y) \}$

$\mu_{\bar{A}}(x \wedge y) \geq \max\{ \mu_{\bar{A}}(x) , \mu_{\bar{A}}(y) \}$

For (II)

$\nu_{\bar{A}}(x \wedge y) = \mu_A(x \wedge y) \leq \min \{ \mu_A(x) , \mu_A(y) \}$

$= \min \{ \nu_{\bar{A}}(x) , \nu_{\bar{A}}(y) \}$

$\nu_{\bar{A}} (x \Lambda y) \leq \min \{ \nu_{\bar{A}} (x) , \nu_{\bar{A}} (y) \}$

Hence A is an intuitionistic fuzzy meet semi L-ideal.

Definition 1.13

For every intuitionistic fuzzy set A we define C(A)= { < x , K , L > / x ∈ X} where K =min $\mu_A(x)$, L = max ν_A (x) and I(A) = { < x , k , l > / x ∈ X } where k =max ν_A (x) , l = min μ_A (x).

Theorem 1.14

If A is an intuitionistic fuzzy meet semi L- filter then C(A) and I(A) are also intuitionistic fuzzy meet semi L- filters.

Proof

Let A be an intuitionistic fuzzy meet semi L- filter

Consider C(A)= { < x , K , L > / x ∈ X } where K = min μ_A (x) , L = max ν_A (x) and

I(A) = { < x , k , l > / x ∈ X } where k =max ν_A (x) , l = min μ_A (x).

Let x , y ∈ C(A). Then x Λ y ∈ C(A).

Form the definition of C(A), all the members of C(A) have the same membership degree K.

Thus $\mu_A (x) = \mu_A (y)$ = K.

Similarly $\nu_A (x) = \nu_A (y)$ = L

Here we have the case of equality.

Hence C(A) is an intuitionistic fuzzy meet semi L- filter.

Similarly we can prove that I(A) is also an intuitionistic fuzzy meet semi L- filter.

Theorem 1.15

If A = < μ_A , ν_A > is an intuitionistic fuzzy meet semi L-filter. Then the □A = < μ_A , 1-μ_A > is an intuitionistic fuzzy meet semi L- filter of A.

Proof

Let A be intuitionistic fuzzy meet semi L- filter

Let B=□A

Then $\mu_B = \mu_A$, $\nu_B = 1 - \mu_A$

To prove that B is intuitionistic fuzzy meet semi L- filter.

(i)$\mu_B (x \Lambda y) = \mu_A (x \Lambda y)$
$\leq \min \{ \mu_A (x) , \mu_A (y) \}$
$= \min \{ \mu_B (x) , \mu_B (y) \}$

$\mu_B (x \Lambda y) \leq \min \{ \mu_B (x) , \mu_B (y) \}$

(ii) $\nu_B (x \Lambda y) = 1 - \mu_A (x \Lambda y)$
$\geq 1 - \min \{ \mu_A (x) , \mu_A (y) \}$
$= \max \{ 1 - \mu_A (x), 1- \mu_A (y) \}$
$= \max \{\nu_A (x) , \nu_A (y) \}$

$\nu_B (x \Lambda y) \geq \max \{ \nu_A (x) , \nu_A (y) \}$

Hence B is an intuitionistic fuzzy meet semi L- filter

Theorem 1.16

If A = < μ_A , ν_A > is an intuitionistic fuzzy meet semi L- filter. Then ◊A = <1- ν_A , ν_A > is also an intuitionistic fuzzy meet semi L- filter.

Proof

Let A be an intuitionistic fuzzy meet semi L- filter.

Then (i) $\mu_A (x \Lambda y) \leq \min \{ \mu_A (x) , \mu_A (y) \}$

(ii)$\nu_A (x \Lambda y) \geq \max \{ \nu_A (x) , \nu_A (y) \}$

To prove that ◊A = < 1 - ν_A , ν_A > is an intuitionistic fuzzy meet semi L- filter.

Let B = ◊A .(ie) $\mu_B = 1 - \nu_A$, $\nu_B = \nu_A$

(i)$\mu_B (x \Lambda y) = 1 - \nu_A (x \Lambda y)$
$\leq 1 - \max \{ \nu_A (x) , \nu_A (y) \}$
$= \min \{ 1 - \nu_A (x) , 1 - \nu_A (y) \}$
$= \min \{ \mu_B (x) , \mu_B (y) \}$

$\mu_B (x \Lambda y) \leq \min \{\mu_B (x) , \mu_B (y) \}$

(ii) $\nu_B (x \Lambda y) = \nu_A (x \Lambda y)$
$\geq \max \{\nu_A (x) , \nu_A (y) \}$
$= \max \{ \nu_B (x) , \nu_B (y) \}$

$\nu_B (x \Lambda y) \geq \max \{ \nu_B (x) , \nu_B (y) \}$

Hence B is an intuitionistic fuzzy meet semi L- filter.

Theorem 1.17

If A = < μ_A , ν_A > is an intuitionistic fuzzy meet semi L-filter of X, then μ_A and 1 – ν_A are fuzzy meet semi L- filter.

Proof

Let A is an intuitionistic fuzzy meet semi L- filter of X.

(i)Let B = < x , μ_A > be a fuzzy set.

Then $\mu_B = \mu_A$

$\mu_B (x \Lambda y) = \mu_A (x \Lambda y) \leq \min \{ \mu_A (x) , \mu_A (y) \} = \min \{ \mu_B (x) , \mu_B (y) \}$

$\mu_B (x \Lambda y) \leq \min \{ \mu_B (x) , \mu_B (y) \}$

Hence $\mu_B = \mu_A$ is an fuzzy meet semi L-filter.

(ii) Let C = < x , 1 - ν_A > be a fuzzy set.

Then $\mu_C = 1 - \nu_A$

$\mu_C (x \Lambda y) = 1 - \nu_A (x \Lambda y)$
$\leq 1 - \max \{ \nu_A (x) , \nu_A (y) \}$
$= \min \{ 1 - \nu_A (x) , 1 - \nu_A (y) \}$
$= \min \{ \nu_C (x) , \nu_C (y) \}$

$\mu_C (x \Lambda y) \leq \min \{ \nu_C (x) , \nu_C (y) \}$

Hence $\mu_C = 1 - \nu_A$ is an fuzzy meet semi L – filter.

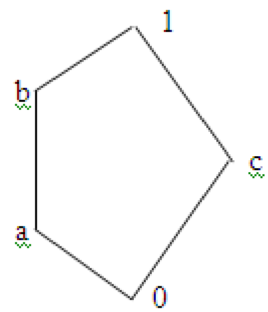
2 LEVEL SET

Definition 2.1

Let μ be any fuzzy meet semi L-filter of a fuzzy meet semilattice A and let t ∈ [0 , 1]. Then μ_t = { x ∈ A / μ(x) ≤ t } is called fuzzy level meet semi L- filter of μ.

Example 2.2

Let A = { 0 , a , b , 1 }. Let μ : A → [0 , 1] is a fuzzy meet set in A defined by μ (0) = 0.4, μ (a) =0.5, μ(b) = 0.6, μ(1) =0.7



Then μ is a fuzzy meet semi L-filter of A.

In this Example t = 0.5, then $\mu_t = \mu_{0.5}$ = {0 , a }.

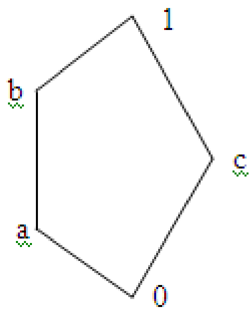
Definition 2.3

Let A = < μ_A , ν_A > be an intuitionistic fuzzy meet semi L-filter and t ∈ [0 , 1]. Then μ_t = { x ∈ A / μ(x) ≤ t

} and $\nu_t = \{ x \in t / \nu(x) \geq t \}$ is called intuitionistic fuzzy level meet semi L- filter of A.

Example 2.4

Let A = { 0 , a , b , 1 }. Let $\mu : A \rightarrow [0 , 1]$ and $\nu : A \rightarrow [0 , 1]$ be a fuzzy meet subsemilattices in A defined by$< \mu (0) , \nu(0) > = < 0.8 , 0.2 >$; $< \mu (a) , \nu(a) > = < 0.5 , 0.5 >$; $< \mu(b) , \nu(b) > = < 0.6 , 0.4 >$; $< \mu(c) , \nu(c) > = < 0.7, 0.3 >$; $< \mu(1) , \nu(1) > = < 0.4 , 0.6 >$.



Then A is an intuitionistic fuzzy meet semi L-filter.
In this case t = 0.6, μ_t = {a , b , 1 }, ν_t = { 1 }.

Theorem 2.5

Let A be fuzzy meet semilattice. If $\mu: A \rightarrow [0 , 1]$, $\nu: A \rightarrow [0 , 1]$ is a intuitionistic fuzzy meet semi L- filter, then the level subsets μ_t , ν_t and $t \in [0 , 1]$ is a intuitionistic fuzzy level meet semi L- filter of A.

Proof

Let x , y $\in \mu_t$. Then $\mu(x) \leq t$, $\mu(y) \leq t$.
$\mu (x \Lambda y) \leq \min \{ \mu (x) , \mu (y) \} \leq t$
Therefore $x \Lambda y \in \mu_t$.
Let x , y $\in \nu_t$. Then $\nu(x) \geq t$, $\nu(y) \geq t$.
$\nu (x \Lambda y) \geq \max \{ \nu (x) , \nu (y) \} \geq t$
Therefore $x \Lambda y \in \nu_t$.
Hence μ_t , ν_t are intuitionistic fuzzy meet semi L- filter of A

Theorem 2.6

If A is a fuzzy meet semilattice. Then A = $< \mu_A , \nu_A >$ is a intuitionistic fuzzy meet semi L- filter iff the level subsets μ_t , ν_t and $t \in [0, 1]$ is a intuitionistic fuzzy level meet semi L- filter of A.

Proof

Let A be a fuzzy meet semilattice.
Assume that A is a intuitionistic fuzzy meet semi L- filter.
Then μ_t , ν_t are intuitionistic fuzzy level meet semi l- filter of A. (by above theorem)
Conversely, assume that μ_t , ν_t are intuitionistic fuzzy level meet semi L- filter of A.
To prove that A is a intuitionistic fuzzy meet semi L- filter.
Let x , y $\in \mu_t$. Then $\mu(x) \leq t$, $\mu(y) \leq t$.
$\min \{ \mu(x) , \mu(y)\} \leq t$
Therefore $x \Lambda y \in \mu_t$.
(ie) $\mu (x \Lambda y) \leq t$
$\mu (x \Lambda y) \leq \min \{ \mu (x) , \mu (y)\}$
Let x , y $\in \nu_t$ .Then $\nu(x) \geq t$, $\nu(y) \geq t$
$\max \{ \nu(x) , \nu(y) \} \geq t$
Therefore $x \Lambda y \in \nu_t$.
(ie) $\nu (x \Lambda y) \geq t$
$\nu (x \Lambda y) \geq \max \{ \nu(x) , \nu(y) \}$
HenceA is an intuitionistic fuzzy meet semi L- filter.

Theorem 2.7

If A = $< \mu_A , \nu_A >$ is an intuitionistic fuzzy meet semi L-filter of X, then B = $< \mu_A , 0 >$ and C = $< 0 , 1 - \mu_A >$ are intuitionistic fuzzy meet semi L- filter of X.

Proof

Given A is an intuitionistic fuzzy meet semi L- filter of X.
To prove that B and C are intuitionistic fuzzy meet semi L-filter.
If B = $< \mu_A , 0 >$ then $\mu_B = \mu_A$, $\nu_B = 0$
Let x , y $\in$ X.
Then $\mu_B (x \Lambda y) = \mu_A (x \Lambda y) \leq \min \{ \mu_A (x) , \mu_A (y) \}$
$= \min \{ \mu_B (x) , \mu_B (y)\}$
$\mu_B (x \Lambda y) \leq \min \{ \mu_B (x) , \mu_B (y) \}$
$\nu_B (x \Lambda y) = 0 \geq \max \{ \nu_B (x) , \nu_B (y) \}$
Hence B is an intuitionistic fuzzy meet semi L- filter.
Let C = $< 0 , 1 - \mu_A >$. Then $\mu_C = 0$, $\nu_C = 1 - \mu_A$
$\mu_C (x \Lambda y) = 0 \leq \min \{ \mu_C (x) , \mu_C (y) \}$
$\nu_C (x \Lambda y) = 1 - \mu_A (x \Lambda y) \geq \max \{ 1 - \mu_A (x) , 1 - \mu_A (y) \}$
$\nu_C (x \Lambda y) \geq \max \{ \mu_C (x), \mu_C (y) \}$.
Hence C is an intuitionistic fuzzy meet semi L- filter.

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