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INTUITIONISTIC FUZZY SEMI-GENERALIZED IRRESOLUTE MAPPINGS

R. SANTHI and K. ARUN PRAKASH

Abstract. The purpose of this paper is to introduce and study the concepts of intuitionistic fuzzy semi-generalized continuous mappings and intuitionistic fuzzy semi-generalized irresolute mappings in intuitionistic fuzzy topological space.

1. Introduction

The concept of fuzzy set was introduced by Zadeh in his classical paper [14] in 1965. Using the concept of fuzzy sets, Chang [3] introduced the concept of fuzzy topological space. In [1], Atanassov introduced the notion of intuitionistic fuzzy sets in 1986. Using the notion of intuitionistic fuzzy sets, Coker [4] defined the notion of intuitionistic fuzzy topological spaces in 1997. This approach provided a wide field for investigation in the area of fuzzy topology and its applications. One of the directions is related to the properties of intuitionistic fuzzy sets introduced by Gurcay [6] in 1997.

Continuing the work done in the paper [12], we define the notion of intuitionistic fuzzy semi-generalized continuous mappings and intuitionistic fuzzy semi-generalized irresolute mappings. We discuss characterizations of intuitionistic fuzzy semi-generalized continuous mappings and irresolute mappings. We also established their properties and relationships with other classes of early defined forms of intuitionistic continuous mappings.

2. Preliminaries

Definition 2.1 ([1])**.** An intuitionistic fuzzy set (IFS, for short) A in X is an object having the form

$$A = \{\langle x, \mu_A(x), \gamma_A(x)\rangle \mid x \in X\}$$

where the functions $\mu_A : X \to [0,1]$ and $\gamma_A : X \to [0,1]$ denote the degree of the membership (namely $\mu_A(x)$) and the degree of non- membership (namely $\gamma_A(x)$) of each element $x \in X$ to the set A, respectively, $0 \le \mu_A(x) + \gamma_A(x) \le 1$ for each $x \in X$.

Corresponding author: R. Santhi.
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Definition 2.2 ([1]). Let A and B be IFS's of the forms $A = \{\langle x, \mu_A(x), \gamma_A(x)\rangle \mid x \in X\}$ and $B = \{\langle x, \mu_B(x), \gamma_B(x)\rangle \mid x \in X\}$. Then,

(a) $A \le B$ if and only if $\mu_A(x) \le \mu_B(x)$ and $\gamma_A(x) \ge \gamma_B(x)$ for all $x \in X$,

(b) $A = B$ if and only if $A \le B$ and $B \le A$,

(c) $\bar{A} = \{\langle x, \gamma_A(x), \mu_A(x)\rangle \mid x \in X\}$,

(d) $A \cap B = \{\langle x, \mu_A(x) \wedge \mu_B(x), \gamma_A(x) \vee \gamma_B(x) \mid x \in X\}$,

(e) $A \cup B = \{\langle x, \mu_A(x) \vee \mu_B(x), \gamma_A(x) \wedge \gamma_B(x) \mid x \in X\}$,

(f) $0_\sim = \{\langle x, 0, 1\rangle, x \in X\}$ and $1_\sim = \{\langle x, 1, 0\rangle, x \in X\}$,

(g) $\overline{\overline{A}} = A$, $\overline{1_\sim} = 0_\sim$ and $\overline{0_\sim} = 1_\sim$.

Definition 2.3 ([1]). Let $\alpha, \beta \in [0,1]$ with $\alpha + \beta \le 1$. An intuitionistic fuzzy point (IFP), written as $p_{(\alpha,\beta)}$, is defined to be an IFS of X given by

$$p_{(\alpha,\beta)}(x) = \begin{cases} (\alpha,\beta), & \text{if } x = p, \\ (0,1), & \text{otherwise.} \end{cases}$$

Definition 2.4 ([4]). An intuitionistic fuzzy topology (IFT for short) on X is a family τ of IFS's in X satisfying the following axioms:

(i) $0_\sim, 1_\sim \in \tau$,

(ii) $G_1 \cap G_2 \in \tau$ for any $G_1, G_2 \in \tau$,

(iii) $\cup G_i \in \tau$ for any family $\{G_i \mid i \in J\} \subseteq \tau$.

In this case the pair (X,τ) is called an intuitionistic fuzzy topological space (IFTS for short) and any IFS in τ is known as an intuitionistic fuzzy open set (IFOS for short) in X. The complement $\bar{A}$ of an IFOS A in IFTS(X,τ) is called an intuitionistic fuzzy closed set (IFCS for short) in X.

Definition 2.5 ([1]). Let f be a mapping from a set X to a set Y. If

$$B = \{\langle y, \mu_B(y), \gamma_B(y)\rangle; y \in Y\}$$

is an IFS in Y, then the *preimage* of B under f, denoted by $f^{-1}(B)$, is the IFS in X defined by

$$f^{-1}(B) = \{\langle x, f^{-1}(\mu_B(x)), f^{-1}(\gamma_B(x))\rangle; x \in X\}.$$

Definition 2.6 ([4]). Let (X,τ) be an IFTS and $A = \langle x, \mu_A, \gamma_A\rangle$ be an IFS in X. Then the intuitionistic fuzzy interior and intuitionistic fuzzy closure of A are defined by

$$\text{int}(A) = \cup\{G \mid G \text{ is an IFOS in } X \text{ and } G \subseteq A\},$$

$$\mathrm{cl}(A) = \cap\{K \mid K \text{ is an IFCS in } X \text{ and } A \subseteq K\}.$$

Note that, for any IFS A in (X,τ), we have

$$\mathrm{cl}(\bar{A}) = \overline{\mathrm{int}(A)} \quad \text{and} \quad \mathrm{int}(\bar{A}) = \overline{\mathrm{cl}(A)}.$$

Definition 2.7. An IFS $A = \{\langle x, \mu_A(x), \gamma_A(x)\rangle \mid x \in X\}$ in an IFTS (X,τ) is called

(i) intuitionistic fuzzy semi open set (IFSOS) if $A \subseteq \mathrm{cl}(\mathrm{int}(A))$. [6]

(ii) intuitionistic fuzzy α-open set (IFαOS) if $A \subseteq \mathrm{int}(\mathrm{cl}(\mathrm{int}(A)))$.[6]

(iii) intuitionistic fuzzy preopen set (IFPOS) if $A \subseteq \mathrm{int}(\mathrm{cl}(A))$.[6]

(iv) intuitionistic fuzzy regular open set (IFROS) if $\mathrm{int}(\mathrm{cl}(A)) = A$.[6]

(v) intuitionistic fuzzy semi-pre open set (IFSPOS) if there exists $B \in \mathrm{IFPO}(X)$ such that $B \subseteq A \subseteq \mathrm{cl}(B)$.[13]

An IFS A is called intuitionistic fuzzy semi closed set, intuitionistic fuzzy α-closed set , intuitionistic fuzzy preclosed set, intuitionistic fuzzy regular closed set and intuitionistic fuzzy semi-preclosed set, respectively (IFSCS, IFαCS, IFPCS, IFRCS and IFSPCS resp), if the complement $\bar{A}$ is an IFSOS, IFαOS, IFPOS, IFROS and IFSPOS respectively.

The family of all intuitionistic fuzzy semi open (resp. intuitionistic fuzzy α-open, intuitionistic fuzzy preopen, intuitionistic fuzzy regular open and intuitionistic fuzzy semi-preopen) sets of an IFTS (X,τ) is denoted by IFSO(X) (resp IF$\alpha(X)$, IFPO(X), IFRO(X) and IFSPO(X)).

Definition 2.8 ([12])**.** An intuitionistic fuzzy set A of an intuitionistic fuzzy topological space (X,τ) is called an intuitionistic fuzzy semi-generalized closed set (IFSGCS) if $\mathrm{scl}(A) \subseteq U$, whenever $A \subseteq U$ and U is intuitionistic fuzzy semi-open set.

The complement $\bar{A}$ of intutitionistic fuzzy semi-generalized closed set A is called intuitionistic fuzzy semi-generalized open set (IFSGOS).

Definition 2.9 ([12])**.** An intuitionistic fuzzy topological space (X,τ) is said to be intuitionistic fuzzy semi-$T_{1/2}$ space, if every intuitionistic fuzzy sg-closed set in X is intuitionistic fuzzy semi- closed in X.

Definition 2.10 ([8])**.** Let $p(\alpha,\beta)$ be an IFP of an IFTS(X,τ). An IFS A of X is called an intuitionistic fuzzy neighbourhood (IFN) of $p(\alpha,\beta)$, if there exists an IFOS B in X such that $p(\alpha,\beta) \in B \subseteq A$.

Definition 2.11. Let $f : X \to Y$ be a mapping from an IFTS X into an IFTS Y. The mapping f is called

(i) *intuitionistic fuzzy continuous*, if $f^{-1}(B)$ is an IFOS in X, for each IFOS B in Y.[6]

(ii) *intuitionistic fuzzy semi-continuous*, if $f^{-1}(B)$ is an IFSOS in X, for each IFOS B in Y.[6]

(iii) *intuitionistic fuzzy pre-continuous*, if $f^{-1}(B)$ is an IFPOS in X, for each IFOS B in Y.[6]

(iv) *intuitionistic fuzzy α-continuous*, if $f^{-1}(B)$ is an IFαOS in X, for each IFOS B in Y.[6]

(v) *intuitionistic fuzzy semi-pre continuous*, if $f^{-1}(B)$ is an IFSPOS in X, for each IFOS B in Y.[13]

(vi) *intuitionistic fuzzy completely continuous*, if $f^{-1}(B)$ is an IFROS in X, for each IFOS B in Y.[15]

Lemma 2.12 ([15])**.** *Let $g : X \to X \times Y$ be the graph of a function $f : X \to Y$. If A is an IFS of X and B is an IFS of Y, then $g^{-1}(A \times B)(x) = (A \cap f^{-1}(B))(x)$.*

3. Intuitionistic fuzzy semi-generalized continuous mappings

In this section we introduce intuitionistic fuzzy semi-generalized continuous mappings and studied some of the properties regarding it.

Definition 3.1. Let A be an IFS in an IFTS (X,τ). Then the intuitionistic fuzzy semi-generalized interior and intuitionistic fuzzy semi-generalized closure of A are defined as follows.

$$\begin{aligned} \text{sgint}(A) &= \cup\{G \mid G \text{ is an IFSGOS in } X \text{ and } G \subseteq A\}, \\ \text{sgcl}(A) &= \cap\{K \mid K \text{ is an IFSGCS in } X \text{ and } A \subseteq K\}. \end{aligned}$$

Example 3.2. Let $X = \{a,b\}$.

$$\begin{aligned} \text{Let } A &= \left\langle x, \begin{pmatrix} \frac{a}{0.2}, \frac{b}{0.3} \end{pmatrix}, \begin{pmatrix} \frac{a}{0.7}, \frac{b}{0.7} \end{pmatrix} \right\rangle \\ B &= \left\langle x, \begin{pmatrix} \frac{a}{0.4}, \frac{b}{0.7} \end{pmatrix}, \begin{pmatrix} \frac{a}{0.6}, \frac{b}{0.1} \end{pmatrix} \right\rangle. \end{aligned}$$

Then $\tau = \{0_\sim, 1_\sim, A, B\}$ is an IFTS on X.

Then $\text{sgint}(B) = A \cup 0_\sim = A$ and $\text{sgcl}(B) = 1_\sim$.

Proposition 3.3. *If A be an IFS in X, then $A \le sgcl(A) \le scl(A) \le cl(A)$.*

Proof. The result follows from Definition. □

Theorem 3.4. *If A is an IFSGCS in X, then $sgcl(A) = A$.*

Proof. Since A is an IFSGCS, $\text{sgcl}(A)$ is the smallest IFSGCS which contains A, which is nothing but A. Hence $\text{sgcl}(A) = A$. □

Theorem 3.5. *If A is an IFSGOS in X, then $sgint(A) = A$.*

Proof. Similar to the above theorem. □

Definition 3.6. Let (X,τ) and (Y,κ) be IFT's. A mapping $f : X \to Y$ is called intuitionistic fuzzy semi-generalized continuous (intuitionistic fuzzy sg-continuous), if $f^{-1}(B)$ is an IFSGCS in X for every IFCS B in Y.

Theorem 3.7. *Every intuitionistic fuzzy continuous mapping is an intuitionistic fuzzy sg-continuous mapping.*

Proof. Let B be an IFCS in Y. Then by our assumption, $f^{-1}(B)$ is an IFCS in X. In [12], it has been proved that every intuitionistic fuzzy closed set is an intuitionistic fuzzy sg-closed set in X. Thus $f^{-1}(B)$ IFSGCS in X. Hence f is an intuitionistic fuzzy sg-continuous mapping. □

The following example shows that the converse of above theorem is not true in general.

Example 3.8. Let $X = \{a,b\}$, $Y = \{c,d\}$.

$$\text{Let } A = \left\langle x, \begin{pmatrix} \frac{a}{0.3}, \frac{b}{0.4} \end{pmatrix}, \begin{pmatrix} \frac{a}{0.7}, \frac{b}{0.6} \end{pmatrix} \right\rangle$$
$$B = \left\langle x, \begin{pmatrix} \frac{c}{0.7}, \frac{d}{0.8} \end{pmatrix}, \begin{pmatrix} \frac{c}{0.3}, \frac{d}{0.2} \end{pmatrix} \right\rangle.$$

Then $\tau = \{0_\sim, 1_\sim, A\}$ and $\kappa = \{0_\sim, 1_\sim, B\}$ are IFTS on X and Y respectively. Define a mapping $f : (X,\tau) \to (Y,\kappa)$ by $f(a) = c$, $f(b) = d$. Clearly f is intuitionistic fuzzy sg-continuous map.

Now we have $f^{-1}(B) = \left\langle x, \begin{pmatrix} \frac{a}{0.7}, \frac{b}{0.8} \end{pmatrix}, \begin{pmatrix} \frac{a}{0.3}, \frac{b}{0.2} \end{pmatrix} \right\rangle$. $f^{-1}(B) \notin \tau$, which shows that f is not an intuitionistic fuzzy continuous map.

Theorem 3.9. *Every intuitionistic fuzzy α-continuous mapping is an intutitionistic fuzzy sg-continuous mapping.*

Proof. Let B be an IFCS in Y. Since f is an intutitionistic fuzzy α-continuous mapping, $f^{-1}(B)$ is an intuitionistic fuzzy α-closed set in X. In [12], it has been proved that every IFαCS is an intuitionistic fuzzy sg-closed set in X. Thus $f^{-1}(B)$ IFSGCS in X. Hence f is an intuitionistic fuzzy sg-continuous mapping. □

The following example shows that the converse of the above theorem is not true in general.

Example 3.10. Let $X = \{a, b\}$, $Y = \{u, v\}$.

$$\text{Let } A = \left\langle x, \left(\frac{a}{0.7}, \frac{b}{0.5}\right), \left(\frac{a}{0.3}, \frac{b}{0.5}\right)\right\rangle$$
$$B = \left\langle y, \left(\frac{u}{0.25}, \frac{v}{0.3}\right), \left(\frac{u}{0.2}, \frac{v}{0.2}\right)\right\rangle.$$

Then $\tau = \{0_\sim, 1_\sim, A\}$ and $\kappa = \{0_\sim, 1_\sim, B\}$ are IFTS on X and Y respectively. Define a mapping $f : (X, \tau) \to (Y, \kappa)$ by $f(a) = u$, $f(b) = v$. Clearly f is intuitionistic fuzzy sg-continuous map.

Now we have $f^{-1}(B) = \left\langle x, \left(\frac{a}{0.25}, \frac{b}{0.3}\right), \left(\frac{a}{0.2}, \frac{b}{0.2}\right)\right\rangle$.

$\text{cl}(f^{-1}(B)) = 1_\sim$, $\text{int}(\text{cl}(f^{-1}(B))) = \text{int}(1_\sim) = 1_\sim$

$\text{cl}(\text{int}(\text{cl}(f^{-1}(B)))) = \text{cl}(1_\sim) = 1_\sim$. Thus $\text{cl}(\text{int}(\text{cl}(f^{-1}(B)))) \nsubseteq f^{-1}(B)$, which shows that f is not an intuitionistic fuzzy α-continuous map.

Thus the class of intuitionistic fuzzy α-continuous maps is properly contained in the class of intutitionistic fuzzy sg-continuous maps.

Forthcoming theorem and example shows that the class of intuitionistic fuzzy semi-continuous maps is properly contained in the class of intuitionistic fuzzy sg-continuous maps.

Theorem 3.11. *Every intuitionistic fuzzy semi-continuous mapping is intuitionistic fuzzy sg-continuous mapping.*

Proof. Let $f : X \to Y$ be any function from IFTS X in to Y such that f is intuitionistic fuzzy semi-continuous. By definition of intuitionistic fuzzy semi-continuous, $f^{-1}(A)$ is IFSCS in X for every IFCS A in Y. In [12], it has been proved that every intuitionistic fuzzy semi-closed set is an intuitionistic fuzzy sg-closed set in X. Thus $f^{-1}(B)$ IFSGCS in X. Hence f is an intuitionistic fuzzy sg-continuous mapping.

The converse of the above theorem is not true as seen from the following example. □

Example 3.12. Let $X = \{a, b\}$, $Y = \{u, v\}$.

$$\text{Let } A = \left\langle x, \left(\frac{a}{0.2}, \frac{b}{0.4}\right), \left(\frac{a}{0.6}, \frac{b}{0.25}\right)\right\rangle$$
$$B = \left\langle y, \left(\frac{u}{0.3}, \frac{v}{0.5}\right), \left(\frac{u}{0.4}, \frac{v}{0.5}\right)\right\rangle.$$

Then $\tau = \{0_\sim, 1_\sim, A\}$ and $\kappa = \{0_\sim, 1_\sim, B\}$ are IFTS on X and Y respectively. Define a mapping $f : X \to Y$ by $f(a) = u$, $f(b) = v$. Clearly f is intuitionistic fuzzy sg-continuous map.

Now we have $f^{-1}(B) = \left\langle x, \left(\frac{a}{0.3}, \frac{b}{0.5}\right), \left(\frac{a}{0.4}, \frac{b}{0.5}\right)\right\rangle$.

$\mathrm{cl}(f^{-1}(B)) = 1_\sim$. $\mathrm{int}[\mathrm{cl}(f^{-1}(B))] = \mathrm{int}(1_\sim) = 1_\sim$. Thus $\mathrm{int}[\mathrm{cl}(f^{-1}(B))] \nsubseteq f^{-1}(B)$, which shows that '$f$' is not intuitionistic fuzzy semi-continuous mapping.

Theorem 3.13. *Every intuitionistic fuzzy sg-continuous mapping is intuitionistic fuzzy semi-pre continuous mapping.*

Proof. Let B be an IFCS in Y. Since f is intuitionistic fuzzy sg-continuous map, $f^{-1}(B)$ is an intuitionistic fuzzy sg-closed set in X. In paper [12], it has been proved that, every intuitionistic fuzzy sg-closed set is an intuitionistic fuzzy semi-pre closed set. Therefore $f^{-1}(B)$ is an IFSPCS in X. Hence f is an intuitionistic fuzzy semi-pre continuous mapping. □

The converse of the above theorem is not true as seen from the following example.

Example 3.14. Let $X = \{a, b\}$, $Y = \{u, v\}$.

$$\text{Let } A = \left\langle x, \left(\frac{a}{0.4}, \frac{b}{0.5}\right), \left(\frac{a}{0.1}, \frac{b}{0.3}\right)\right\rangle$$

$$B = \left\langle y, \left(\frac{u}{0.15}, \frac{v}{0.3}\right), \left(\frac{u}{0.5}, \frac{v}{0.7}\right)\right\rangle.$$

Then $\tau = \{0_\sim, 1_\sim, A\}$ and $\kappa = \{0_\sim, 1_\sim, B\}$ are IFTS on X and Y respectively. Define a mapping $g : (X, \tau) \to (Y, \kappa)$ by $g(a) = u$, $g(b) = v$. Clearly g is intuitionistic fuzzy semi-pre continuous map. Infact we have

$$g^{-1}(B) = \left\langle x, \left(\frac{a}{0.15}, \frac{b}{0.3}\right), \left(\frac{a}{0.5}, \frac{b}{0.7}\right)\right\rangle$$

$\mathrm{scl}(g^{-1}(B)) = 1_\sim \nsubseteq A$. Hence g is not intuitionistic fuzzy semi-generalized continuous mapping.

Remark 3.15. Intuitionistic fuzzy pre-continuity is independent from intuitionistic fuzzy sg-continuity.

The proof follows from the following examples.

Example 3.16. Let $X = \{a, b\}$, $Y = \{u, v\}$.

$$\text{Let } A = \left\langle x, \left(\frac{a}{0.3}, \frac{b}{0.4}\right), \left(\frac{a}{0.7}, \frac{b}{0.6}\right)\right\rangle$$

$$B = \left\langle y, \left(\frac{u}{0.6}, \frac{v}{0.5}\right), \left(\frac{u}{0.4}, \frac{v}{0.5}\right)\right\rangle.$$

Then $\tau = \{0_\sim, 1_\sim, A\}$ and $\kappa = \{0_\sim, 1_\sim, B\}$ are IFTS on X and Y respectively. Define a mapping $f : (X, \tau) \to (Y, \kappa)$ by $f(a) = u$, $f(b) = v$. Clearly f is intuitionistic fuzzy sg-continuous map. Infact we have

$$f^{-1}(B) \left\langle x, \left(\frac{a}{0.15}, \frac{b}{0.3} \right), \left(\frac{a}{0.5}, \frac{b}{0.7} \right) \right\rangle$$

$(\mathrm{cl}(f^{-1}(B)) = 1_\sim \cap \bar{A} = \bar{A}$. $\mathrm{int}[\mathrm{cl}(f^{-1}(B))] = \mathrm{int}(\bar{A}) = 0_\sim \cup A = A$. Hence $f^{-1}(B) \not\subseteq A = \mathrm{int}[\mathrm{cl}(f^{-1}(B))]$ which shows that f is not an intuitionistic fuzzy pre-continuous map.

Example 3.17. Let $X = \{a, b\}$, $Y = \{u, v\}$.

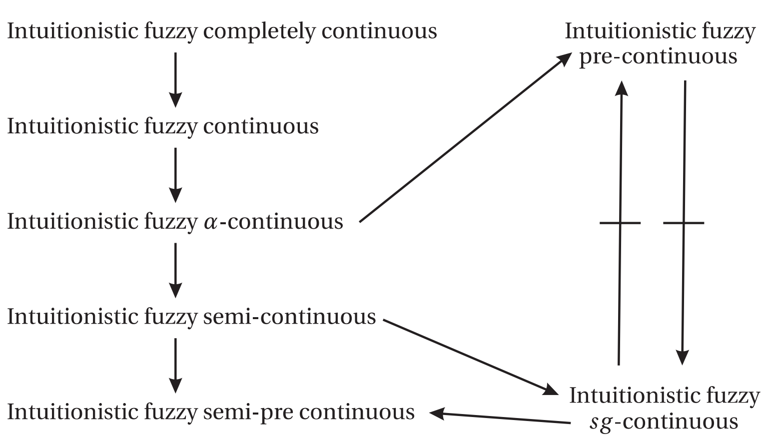
$$\text{Let } A = \left\langle x, \left(\frac{a}{0.4}, \frac{b}{0.5} \right), \left(\frac{a}{0.5}, \frac{b}{0.6} \right) \right\rangle$$

$$B = \left\langle y, \left(\frac{u}{0.2}, \frac{v}{0.3} \right), \left(\frac{u}{0.4}, \frac{v}{0.7} \right) \right\rangle.$$

Then $\tau = \{0_\sim, 1_\sim, A\}$ and $\kappa = \{0_\sim, 1_\sim, B\}$ are IFTS on X and Y respectively. Define a mapping $h : (X, \tau) \to (Y, \kappa)$ by $h(a) = u$, $h(b) = v$. Clearly h is intuitionistic fuzzy pre-continuous map. Infact we have

$$h^{-1}(B) = \left\langle x, \left(\frac{a}{0.2}, \frac{b}{0.3} \right), \left(\frac{a}{0.4}, \frac{b}{0.7} \right) \right\rangle$$

$\mathrm{scl}(h^{-1}(B)) = 1_\sim$. $h^{-1}(B) \subset A$, but $\mathrm{scl}(h^{-1}(B)) \not\subset A$, which shows that f is not an intuitionistic fuzzy sg-continuous map.



The above diagram shows the relationships between intuitionistic fuzzy sg-continuous mappings and some other mappings. The reverse implications are not true in the above diagram.

Theorem 3.18. *Let $f : X \to Y$ be a mapping from a IFTS X into an IFTS Y. Then the following statements are equivalent.*

(i) *f is intuitionistic fuzzy sg-continuous mapping.*

(ii) *$f^{-1}(B)$ is an IFSGOS in X, for every IFOS B in X.*

Proof. (i)⇒(ii) Let B be an IFOS in Y, then $\bar{B}$ is an IFCS in Y. Since f is intuitionistic fuzzy sg-continuous mapping $f^{-1}(\bar{B})$ is an IFSGCS in X. Then $f^{-1}(\bar{B}) = \overline{f^{-1}(B)}$, implies $f^{-1}(B)$ is an IFSGOS in Y.

(ii)⇒(i) Let B be an IFCS in Y. By our assumption $f^{-1}(\bar{B})$ is an IFSGOS in X for every IFOS $\bar{B}$ in Y. But $f^{-1}(\bar{B}) = \overline{f^{-1}(B)}$, which in turn implies $f^{-1}(B)$ is an IFSGCS in X. Hence f is intuitionistic fuzzy sg-continuous mapping. □

Theorem 3.19. *Let $f : X \to Y$ be an intuitionistic fuzzy sg-continuous mapping. Then the following statements hold.*

(i) *$f(sgc1(A)) \leq c1(f(A))$, for every intuitionistic fuzzy set A in X.*

(ii) *$sgc1(f^{-1}(B)) \leq f^{-1}(c1(B))$ for every intuitionistic fuzzy set B in Y.*

Proof. (i) Let $A \leq X$. Then $\mathrm{c1}(f(A))$ is an intuitionistic fuzzy closed set in Y. Since f is intuitionistic fuzzy sg-continuous, $f^{-1}[\mathrm{c1}[f(A)]]$ is intuitionistic fuzzy sg-closed in X. Since $A \leq f^{-1}(f(A)) \leq f^{-1}[\mathrm{c1}[f(A)]]$ and $f^{-1}[\mathrm{c1}[f(A)]]$ is intuitionistic fuzzy sg-closed, implies $\mathrm{sgc1}(A) \leq f^{-1}[\mathrm{c1}(f(A))]$. Hence $f[\mathrm{sgc1}(A)] \leq \mathrm{c1}[f(A)]$.

(ii) Replacing A by $f^{-1}(B)$ in (i), we get

$$f[\mathrm{sgcl}(f^{-1}(B))] \leq \mathrm{c1}[f(f^{-1}(B))] = \mathrm{c1}(B)$$

$$f[\mathrm{sgcl}(f^{-1}(B))] \leq \mathrm{c1}(B)$$

Hence $\mathrm{sgc1}[f^{-1}(B)] \leq f^{-1}[\mathrm{c1}(B)]$. □

Theorem 3.20. *Let $f : X \to Y$ be a function and $g : X \to X \times Y$ the graph of the function f. Then f is intuitionistic fuzzy sg-continuous if g is so.*

Proof. Let B be an IFOS in Y. Then by **Lemma 2.11**, $f^{-1}(B) = f^{-1}(1_\sim \times B) = 1_\sim \cap f^{-1}(B) = g^{-1}(1_\sim \times B)$. Since B is an IFOS Y, $1_\sim \times B$ is an IFOS in $X \times Y$. Also since g is intuitionistic fuzzy sg-continuous implies that $g^{-1}(1_\sim \times B)$ is an IFSGOS in X. Therefore $f^{-1}(B)$ is an IFSGOS in X. Hence f is intuitionistic fuzzy sg-continuous mapping. □

Theorem 3.21. *Let $f : X \to Y$ is a mapping from an IFTS X into an IFTS Y. If any union of IFSGCS is IFSGCS, then the following statements are equivalent.*

(i) *f is intuitionistic fuzzy sg-continuous mapping.*

(ii) *For each IFP $p_{(\alpha,\beta)} \in X$ and every IFN A of $f(p_{(\alpha,\beta)})$, there exists an IFSGCS B such that $p_{(\alpha,\beta)} \in B \leq f^{-1}(A)$.*

(iii) *For each IFP $p_{(\alpha,\beta)} \in X$ and every IFN A of $f(p_{(\alpha,\beta)})$, there exists an IFSGCS B such that $p_{(\alpha,\beta)} \in B$ and $f(B) \leq A$.*

Proof. (i)⇒(ii): Assume that f is intuitionistic fuzzy sg-continuous. Let $p_{(\alpha,\beta)}$ be an IFP in X and A be an IFN of $f(p_{(\alpha,\beta)})$. Then by Definition of IFN, there exists an IFCS C in Y, such that $f(p_{(\alpha,\beta)}) \in C \leq A$. Taking $B = f^{-1}(C) \in X$, since f is intuitionistic fuzzy sg-continuous, $f^{-1}(C)$ is IFSGCS and

$$p_{(\alpha,\beta)} \in B \leq f^{-1}[f(p_{(\alpha,\beta)})] \leq f^{-1}(C) = B \leq f^{-1}(A).$$

Hence $p_{(\alpha,\beta)} \in B \leq f^{-1}(A)$.

(ii)⇒(iii): Let $p_{(\alpha,\beta)}$ be an IFP in X and A be an IFN of $f(p_{(\alpha,\beta)})$, such that there exists an IFSGCS B with $p_{(\alpha,\beta)} \in B \leq f^{-1}(A)$. From this we have $p_{(\alpha,\beta)} \in B$ and $B \leq f^{-1}(A)$. This implies $f(B) \leq f(f^{-1}(A)) = A$. Hence (iii) holds.

(iii)⇒(i): Assume that (iii) holds. Let B be an IFCS in Y and take $p_{(\alpha,\beta)} \in f^{-1}(B)$. Then $f(p_{(\alpha,\beta)}) \in f(f^{-1}(B)) \leq B$. Since B is IFCS in Y, it follows that B is an IFN of $f(p_{(\alpha,\beta)})$. Then from (iii), there exists an IFSGCS A such that $p_{(\alpha,\beta)} \in A$ and $f(A) \leq B$. This shows that $p_{(\alpha,\beta)} \in A \leq f^{-1}(f(A)) \leq f^{-1}(B)$. (i.e) $p_{(\alpha,\beta)} \in A \subseteq f^{-1}(B)$. Since $p(\alpha,\beta)$ is an arbitrary IFP and $f^{-1}(B)$ is union of all IFP contained in $f^{-1}(B)$, by assumption $f^{-1}(B)$ is an IFSGCS. Hence f is intuitionistic fuzzy sg-continuous mapping. □

Theorem 3.22. *Let $f : X \to Y$ is a mapping from an IFTS X into an IFTS Y. Then the following statements are equivalent.*

(i) *f is intuitionistic fuzzy sg-continuous mapping.*

(ii) *$f^{-1}(B)$ is an IFSGOS in X, for every IFOS B in X.*

(iii) *$f(sgc1(A)) \leq c1(f(A))$, for every fuzzy set A in X.*

(iv) *$sgc1(f^{-1}(B)) \leq f^{-1}(c1(B))$ for every fuzzy set B in Y.*

(v) *For each IFP $p_{(\alpha,\beta)} \in X$ and every IFN A of $f(p_{(\alpha,\beta)})$, there exists an IFSGCS B such that $p_{(\alpha,\beta)} \in B \leq f^{-1}(A)$.*

(vi) *For each IFP $p_{(\alpha,\beta)} \in X$ and every IFN A of $f(p_{(\alpha,\beta)})$, there exists an IFSGCS B such that $p_{(\alpha,\beta)} \in B$ and $f(B) \leq A$.*

Proof. Follows form the **Theorems.3.18, 3.19 and 3.22**. □

Theorem 3.23. *If $f : X \to Y$ is intuitionistic fuzzy sg-continuous and $g : Y \to Z$ is intuitionistic fuzzy completely continuous, then $g \circ f : X \to Z$ is intuitionistic fuzzy sg-continuous.*

Proof. Let B be any IFCS in Z. Since g is intuitionistic fuzzy completely continuous, $g^{-1}(B)$ is an IFRCS in Y. In [6], it has been proved that every IFRCS is an IFCS. Therefore $g^{-1}(B)$ is an IFCS in Y. Also since f is intuitionistic fuzzy sg-continuous mapping $f^{-1}[g^{-1}(B)]$ is an IFSGCS in X.

We have $(g \circ f)^{-1}[B] = f^{-1}[g^{-1}(B)]$ is IFSGCS in X, for every IFCS B in Z. Hence $g \circ f$ is intuitionistic fuzzy sg-continuous mapping. □

Theorem 3.24. *If $f : X \to Y$ is intuitionistic fuzzy sg-continuous and $g : Y \to Z$ is intuitionistic fuzzy continuous, then $g \circ f : X \to Z$ is intuitionistic fuzzy sg-continuous.*

Proof. Let B be any intuitionistic fuzzy closed set in Z. Since g is intuitionistic fuzzy continuous, $g^{-1}(B)$ is intuitionistic fuzzy closed set in Y. Since f is intuitionistic fuzzy sg-continuous mapping $f^{-1}[g^{-1}(B)]$ is an intuitionistic fuzzy sg-closed set in X.

$(g \circ f)^{-1}[B] = f^{-1}[g^{-1}(B)]$ is intuitionistic fuzzy sg-closed set, for every intuitionistic fuzzy closed B in Z.

Hence $g \circ f$ is intuitionistic fuzzy sg-continuous mapping. □

Theorem 3.25. *Let $f : X \to Y$ is a mapping from an IFTS X into an IFTS Y. If X is intuitionistic fuzzy semi-$T_{1/2}$ space, then f is intuitionistic fuzzy sg-continuous iff it is intuitionistic fuzzy semi-continuous.*

Proof. Let f be intuitionistic fuzzy sg-continuous mapping and let A be an intuitionistic fuzzy closed set in Y. Then by definition of intuitionistic fuzzy semi-generalized continuous $f^{-1}(A)$ is intuitionistic fuzzy sg-closed in X. Since X is intuitionistic fuzzy semi-$T_{1/2}$ space, $f^{-1}(A)$ is intuitionistic fuzzy semi-closed set.

Hence f is intuitionistic fuzzy semi-continuous.

Conversely assume that f is intuitionistic fuzzy semi-continuous. Then by **Theorem 3.11** f is intuitionistic fuzzy sg-continuous mapping. □

Theorem 3.26. *Let X, X_1, X_2 are IFTS's and $p_i : X_1 \times X_2 \to X_i$ $(i = 1, 2)$ are projections of $X_1 \times X_2$ onto X_i. If $f : X \to X_1 \times X_2$ is intuitionistic fuzzy sg-continuous, then $p_i \circ f$ $(i = 1, 2)$ is intuitionistic fuzzy sg-continuous mapping.*

Proof. It follows from the facts that projections are intuitionistic fuzzy continuous mappings. □

4. Intuitionistic fuzzy semi-generalized irresolute mappings

Definition 4.1. A mapping $f : X \to Y$ from an IFTS X into an IFTS Y is said to be intuitionistic fuzzy semi-generalized irresolute (intuitionistic fuzzy sg-irresolute) if $f^{-1}(B)$ is an IFSGCS in X for every IFSGCS B in Y.

Theorem 4.2. *Let $f : X \to Y$ is a mapping from an IFTS X into an IFTS Y. Then every intuitionistic fuzzy sg-irresolute mapping is intuitionistic fuzzy sg-continuous.*

Proof. Assume that $f : X \to Y$ is an intuitionistic fuzzy sg-irresolute mapping and let A be an IFCS in Y. In [12], it has been proved that every intuitionistic fuzzy closed set is an intuitionistic fuzzy sg-closed. Therefore A is an IFSGCS in Y. Since f is intuitionistic fuzzy sg-irresolute, by definition $f^{-1}(A)$ is IFSGCS in X. Hence f is intuitionistic fuzzy sg-continuous. □

Example 4.3. Let $X = \{a, b, c\}$, $Y = \{u, v, w\}$.

$$\text{Let } A = \left\langle x, \left(\frac{a}{0.8}, \frac{b}{0.4}, \frac{c}{0.4}\right), \left(\frac{a}{0.1}, \frac{b}{0.6}, \frac{c}{0.6}\right)\right\rangle$$

$$B = \left\langle y, \left(\frac{u}{1}, \frac{v}{0.4}, \frac{w}{0.4}\right), \left(\frac{u}{0}, \frac{v}{0.6}, \frac{w}{0.6}\right)\right\rangle.$$

Then $\tau = \{0_\sim, 1_\sim, A\}$ and $\kappa = \{0_\sim, 1_\sim, B\}$ are IFTS on X and Y respectively. Define a mapping $h : (X, \tau) \to (Y, \kappa)$ by $h(a) = u$, $h(b) = v$, $h(c) = w$. Clearly h is intuitionistic fuzzy sg-continuous map. Infact we have

$C = \left\langle y, \left(\frac{u}{0.0}, \frac{v}{0.4}, \frac{w}{0.2}\right), \left(\frac{u}{0}, \frac{v}{0.6}, \frac{w}{0.6}\right)\right\rangle$ be an IFSGCS in Y.

$$h^{-1}(C) = \left\langle x, \left(\frac{a}{0.0}, \frac{b}{0.4}, \frac{c}{0.2}\right), \left(\frac{a}{0.0}, \frac{b}{0.6}, \frac{c}{0.6}\right)\right\rangle.$$

$\text{scl}(h^{-1}(C)) = 1_\sim = 1_\sim$. $h^{-1}(C) \subset A$, but $\text{scl}(h^{-1}(C)) \not\subseteq A$, which shows that $h^{-1}(C)$ is not an IFSGCS in X. Therefore f is not an intuitionistic fuzzy sg-irresolute map.

Theorem 4.4. *Let $f : X \to Y$ be a mapping from a IFTS X into an IFTS Y. Then the following statements are equivalent.*

(i) *f is intuitionistic fuzzy sg-irresolute mapping.*
(ii) *$f^{-1}(B)$ is an IFSGOS in X, for every IFSGOS B in X.*

Proof. Similar to **Theorem 3.18**. □

Theorem 4.5. *Let $f : X \to Y$ be a mapping from an IFTS X into an IFTS Y. Then the following statements are equivalent.*

(i) *f is an intuitionistic fuzzy semi-generalized irresolute mapping.*

(ii) *$f^{-1}(B)$ is an IFSGOS in X for each IFSGOS B in Y.*

(iii) *sgcl($f^{-1}(B)$) $\leq f^{-1}$(sgcl(B)), for each IFS B of Y.*

(iv) *f^{-1}(sgint$B$) $\leq$sgint[$f^{-1}(B)$], for each IFS B of Y.*

Proof. (i)⇒(ii) It can be proved by using the complement and **Definition 4.1**.

(ii)⇒(iii) Let B be an IFS in Y. Since $B \leq$sgcl(B), $f^{-1}(B) = f^{-1}$(sgcl(B)). Since sgcl(B) is an IFSGCS in Y, by our assumption, f^{-1}(sgcl(B)) is an IFSGCS in X. Therefore sgcl[$f^{-1}(B)$] $\leq$ f^{-1}(sgcl(B)).

(iii)⇒(iv) By taking complement we get the result.

(iv)⇒(i) Let B be any IFSGOS in Y. Then sgint(B) $= B$. By our assumption we have $f^{-1}(B) =$ f^{-1}(sgint(B)) $\leq$sgint[$f^{-1}(B)$], so $f^{-1}(B)$ is an IFSGOS in X. Hence f is intuitionistic fuzzy sg-irresolute mapping. □

Theorem 4.6. *Let $f : X \to Y$ be intuitionistic fuzzy sg-irresolute mapping. Then f is intuitionistic fuzzy irresolute mapping if (X,τ) is intuitionistic fuzzy semi-$T_{1/2}$ space.*

Proof. Let B be an IFSCS in Y. Then B is an IFSGCS in Y. Since f is intuitionistic fuzzy sg-irresolute, $f^{-1}(B)$ is an IFSGCS in X. But (X,τ) is intuitionistic fuzzy semi-$T_{1/2}$ space implies $f^{-1}(B)$ is an IFSCS in X. Hence f is intuitionistic fuzzy irresolute. □

Theorem 4.7. *If a mapping $f : X \to Y$ is intuitionistic fuzzy sg-irresolute mapping, then f(sgcl(B)) $\leq$scl($f(B)$) for every IFS B of X.*

Proof. Let B be an IFS of X. Since scl($f(B)$) is an IFSGCS in Y, by our assumption f^{-1}[scl ($f(B)$)] is an IFSGCS in X. Furthermore $B \leq f^{-1}(f(B)) \leq f^{-1}$(scl($f(B)$)) and hence sgcl($B$) $\leq$ f^{-1}[scl($f(B)$)] and consequently f[sgcl(B)] $\leq f[f^{-1}$[scl($f(B)$)]] $\leq$scl($f(B)$). □

Theorem 4.8. *Let (Y,κ) be an IFTS such that every IFSCS in Y is an IFCS. If $f : (X,\tau) \to (Y,\kappa)$ is bijective and intuitionistic fuzzy sg-continuous then f is intuitionistic fuzzy sg-irresolute.*

Proof. Let B be an IFSGCS in Y and let $f^{-1}(B) \leq A$, where A is an IFSOS in X. Then $B \leq$ $f(A)$. Since $f(A)$ is an IFSOS in Y and B is an IFSGCS in Y, then scl(B) $\leq f(A)$ and hence f^{-1}(scl(A)) $\leq f^{-1}(f(A)) = A$. Since f is intuitionistic fuzzy sg-continuous and scl(B) is an IFCS in Y, then f^{-1}(scl(B)) is an IFSGCS in X. Therefore scl[f^{-1}(scl(B))] $\leq A$ and so scl($f^{-1}(B)$) $\leq A$. Hence $f^{-1}(B)$ is an IFSGCS in X. Hence f is intuitionistic fuzzy sg-irresolute mapping. □

Theorem 4.9. *Let $f : X \to Y$ be an intuitionistic fuzzy sg-irresolute mappings. Then f is intuitionistic fuzzy irresolute, if (X,τ) is an intuitionistic fuzzy semi-$T_{1/2}$ space.*

Proof. Let A be any IFSCS in Y. In [12], it has been proved that every IFSCS is an IFSGCS. Therefore A is an IFSGCS in Y and f is an intuitionistic fuzzy sg-irresolute. Then by definition $f^{-1}(A)$ is IFSGCS in X. But (X,τ) is an intuitionistic fuzzy semi-$T_{1/2}$ space, so $f^{-1}(A)$ is an IFSCS. Hence f is an intuitionistic fuzzy irresolute. □

Theorem 4.10. *If any union of IFSGCS is an IFSGCS, then a mapping $f : X \to Y$ from an IFTS X into an IFTS Y is intuitionistic fuzzy sg-irresolute if and only if for each IFP $p_{(\alpha,\beta)}$ in X and IFSGCS B in Y such that $f(p_{(\alpha,\beta)}) \in B$, there exists an IFSGCS A in X such that $p_{(\alpha,\beta)} \in A$ and $f(A) \le B$.*

Proof. Let f be any intuitionistic fuzzy sg-irresolute mapping, $p_{(\alpha,\beta)}$ an IFP in X and B be any IFSGCS in Y, such that $f(p_{(\alpha,\beta)}) \in B$. Then $p_{(\alpha,\beta)} \in f^{-1}(B)$ =sgcl$[f^{-1}(B)]$. We take A =sgcl$[f^{-1}(B)]$. Then A is an IFSGCS in X, containing IFP $p_{(\alpha,\beta)}$ and $f(A) = f[\text{sgcl}(f^{-1}(B))] \le f[f^{-1}(B)] \le B$.

Conversely assume that B be any IFSGCS in Y and IFP $p_{(\alpha,\beta)}$ in X, such that $p_{(\alpha,\beta)} \in f^{-1}(B)$. By assumption there exists IFSGCS A in X such that $p_{(\alpha,\beta)} \in A$ and $f(A) \le B$. Therefore $p_{(\alpha,\beta)} \in A \le f^{-1}(B)$ and $p_{(\alpha,\beta)} \in A$ =sgcl(A) ≤sgcl$[f^{-1}(B)]$. Since $p_{(\alpha,\beta)}$ is an arbitrary IFP and $f^{-1}(B)$ is union of all IFP contained in $f^{-1}(B)$, $f^{-1}(B)$ is an IFSGCS in X, so f is an intuitionistic fuzzy semi-generalized irresolute mapping. □

Corollary 4.11. *A mapping $f : X \to Y$ from an IFTS X into an IFTS Y is intuitionistic fuzzy semi-generalized irresolute if and only if for each IFP $p_{(\alpha,\beta)}$ in X and IFSGCS B in Y such that $f(p_{(\alpha,\beta)}) \in B$, there exists an IFSGCS A in X such that $p_{(\alpha,\beta)} \in A$ and $A \le f^{-1}(B)$.*

Proof. Follows from Theorem 4.10. □

Theorem 4.12. *Let $f : X \to Y$ and $g : Y \to Z$ are intuitionistic fuzzy sg-irresolute mappings, where X, Y, Z are IFTS. Then $g \circ f$ is an intuitionistic fuzzy sg-irresolute mapping.*

Proof. Let A be an intuitionistic fuzzy sg-closed set in Z. Since g is an intuitionistic fuzzy semi-generalized irresolute mapping $g^{-1}(A)$ is an intuitionistic fuzzy sg-closed set in Y. Also since f is intuitionistic fuzzy semi-generalized irresolute mapping, $f^{-1}[g^{-1}(A)]$ is an intuitionistic fuzzy sg-closed set in X.

$(g \circ f)^{-1}(A) = f^{-1}[g^{-1}(A)]$ for each A in Z. Hence $(g \circ f)^{-1}(A)$ is an intuitionistic fuzzy sg-closed set in X. Therefore $g \circ f$ is an intuitionistic fuzzy semi-generalized irresolute mapping. □

Theorem 4.13. *Let $f : X \to Y$ and $g : Y \to Z$ are intuitionistic fuzzy semi-generalized irresolute and intuitionistic fuzzy continuous mappings respectively, where X, Y, Z are IFTS. Then $g \circ f$ is an intuitionistic fuzzy semi-generalized continuous mapping.*

Proof. Let A be any IFCS in Z. Since g is intuitionistic fuzzy semi-generalized continuous, $g^{-1}(A)$ is an IFSGCS in Y. Also, since f is intuitionistic fuzzy semi-generalized irresolute, $f^{-1}[g^{-1}(A)]$ is an IFSGCS in X.

$(g \circ f)^{-1}(A) = f^{-1}[g^{-1}(A)]$ is an IFSGCS in X. Hence $g \circ f$ is intuitionistic fuzzy semi-generalized continuous. □

Theorem 4.14. *Let (X,τ), (Y,κ), (Z,δ) be any intuitionistic fuzzy topological spaces. Let $f : (X,\tau) \to (Y,\kappa)$ be intuitionistic fuzzy semi-generalized irresolute and $g : (Y,\kappa) \to (Z,\sigma)$ is intuitionistic fuzzy continuous, then $g \circ f$ is intuitionistic fuzzy semi-generalized continuous.*

Proof. Let B be any intuitionistic fuzzy closed set in Z. Since g is intuitionistic fuzzy continuous, $g^{-1}(B)$ is IFCS in Y. In paper [12], it has been proved that every IFCS is an IFSGCS. Therefore $f^{-1}(B)$ is an IFSGCS in Y. But since f is an intuitionistic fuzzy sgirresolute mapping $f^{-1}(g^{-1}(B))$ is an IFSGCS in X.

$[g \circ f]^{-1}(B) = f^{-1}(g^{-1}(B))$ is IFSGCS in X for every IFCS 'B' in X.

Hence $g \circ f$ is intuitionistic fuzzy sg-continuous. □

Theorem 4.15. *Let X, X_1, X_2 are IFTS's and $p_i : X_1 \times X_2 \to X_i$ $(i = 1,2)$ are projections of $X_1 \times X_2$ onto X_i. If $f : X \to X_1 \times X_2$ is intuitionistic fuzzy semi-generalized irresolute, then $p_i f$ is intuitionistic fuzzy semi-generalized continuous mapping.*

Proof. $p_i f : X \to X_i$ $(i = 1,2)$. It follows from the fact that p_i $(i = 1,2)$ are intuitionistic fuzzy continuous mappings and by **Theorem 5.5**. □

References

[1] K. T. Atanassov, *Intuitionistic fuzzy sets*, Fuzzy Sets and Systems, **20** (1986), 87–96.

[2] Biljana Krsteska and Salah Abbas, *Intuitionistic fuzzy strongly irresolute precontinuous mappings in Coker's spaces*, Kragujevac. J. Math., **30** (2007), 243–252.

[3] C. L. Chang, *Fuzzy topological spaces*, J. Math. Anal. Appl., **24** (1986), 182–190.

[4] D. Coker, *An introduction to intuitionistic fuzzy topological spaces*, Fuzzy Sets and Systems, **88** (1997), 81–89.

[5] M. E. El-Shafei and A. Zakai, *Semi-generalized continuous mappings in fuzzy topological spaces*, J. Egypt. Math. Soc., **15**(2007), 57–67.

[6] H. Gurcay, D. Coker, *On fuzzy continuity in intuitionistic fuzzy topological spaces*, J. Fuzzy. Math., **5**(1997), 365–378.

[7] J. K. Joen, Y. B. Jun and J. H. Park, *Intuitionistic fuzzy alpha-continuity and intuitionistic fuzzy pre-continuity*, IJMMS, **19**(2005), 3091–3101.

[8] S. J. Lee and E. P. Lee, *The category of intuitionistic fuzzy topological spaces*, Bull. Korean. Math. Soc., **37**(2000), 63–71.

[9] S. S. Thakur and Surendra Singh, *On fuzzy semi-preopen sets and fuzzy semiprecontinuity*, Fuzzy Sets and Systems, **98**(1998), 383–391.

[10] S. S. Thakur and Rekka Chaturvedi, *RG-Closed sets in intuitionistic fuzzy topological spaces*, Universitatea Din Bacau Studii Si Cercertari Stiintifice, Nr. **16** (2006), 257–272.

[11] S. S. Thakur and Rekka Chaturvedi, *Generalized continuity in intuitionistic fuzzy topological spaces*. (Submitted).

[12] R. Santhi and K. Arun Prakash, *Intuitionistic fuzzy semi-generalized closed sets* (Submitted to Korean Mathematical Society).

[13] Young Bae Jun and Seok-Zun Song, *Intuitionistic fuzzy semi-preopen sets and intuitionistic fuzzy semi-precontinuous mappings*, J. Appl. Math & Computing, **19**(2005), 467–474.

[14] L. A. Zadeh, *Fuzzy sets*, Information Control, **8** (1965), 338-353.

[15] I. M. Hanafy, *Completely continuous functions in Intuitionistic fuzzy topological spaces*, Czechoslovak Mathematical Journal, **53**(2003), 793–803.

Department of Mathematics, Nallamuthu Gounder Mahalingam College Pollachi - 642 001.

E-mail: santhifuzzy@yahoo.co.in

Department of Mathematics, Kongu Engineering College Perundurai - 638 052.

E-mail: arun.kannusamy@yahoo.co.in