Intuitionistic Fuzzy Almostβ^{**}G Closed Mappings

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Abstract: The aim of this paper is tointroduce and study the concepts of intuitionistic fuzzy almostβ^{**}generalized closed mappings and intuitionistic fuzzy almost β^{**}generalizedopen mappings.Weinvestigate some of their properties. Also we provide the relations between intuitionistic fuzzy almost β^{**}generalized closed mapping with other intuitionistic fuzzy closed mappings.

Keywords: Intuitionistic fuzzy topology, intuitionistic fuzzy point, intuitionistic fuzzy β^{**}generalized closed mappings, intuitionistic fuzzy β^{**}generalized open mappings,intuitionistic fuzzy almost β^{**}generalizedclosed mappings, intuitionistic fuzzy almostβ^{**}generalized open mappings.

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1. Introduction

Open maps and closed maps are very interesting concepts in topology.Noiri [8] has introduced semi-closed mappings which contain the class of closed mappings.Malghan [7] has introduced generalized closed maps in topology.Seok Jong Lee and EunPyo Lee [9] have introduced intuitionistic fuzzy open mapping and intuitionistic fuzzy closed mapping in intuitionistic fuzzy topological spaces.Sudha and Jayanthi [10] introduced intuitionistic fuzzy β^{**} generalized closed mappings in 2020 and now we have extend our idea towards intuitionistic fuzzy almost β^{**} generalized closed mappings, intuitionistic fuzzy almost β^{**}generalized open mappings. The interrelations with other already existing closed mappings with our newly defined closed mapping have been established.

2. Preliminaries

Definition 2.1: [1]An **intuitionistic fuzzy set** (IFS) A is an object having the form

$$A = \{ \langle x, \mu_A(x), \nu_A(x) \rangle : x \in X\}$$

where the functions $\mu_A : X \to [0, 1]$ and $\nu_A : X \to [0, 1]$ denote the degree of membership (namely $\mu_A(x)$) and the degree of non-membership (namely $\nu_A(x)$) of each element $x \in X$ to the set A respectively, and $0 \leq \mu_A(x) + \nu_A(x) \leq 1$ for each $x \in X$. Denote by IFS(X), the set of all intuitionistic fuzzy sets in X. An intuitionistic fuzzy set A in X is simply denoted by $A = \langle x, \mu_A, \nu_A\rangle$ instead of denoting $A = \{\langle x, \mu_A(x), \nu_A(x) \rangle : x \in X\}$.

Definition 2.2: [1]Let A and B be two IFSs of the form $A = \{ \langle x, \mu_A(x), \nu_A(x) \rangle : x \in X\}$ and $B = \{ \langle x, \mu_B(x), \nu_B(x) \rangle : x \in X\}$. Then,

(a) $A \subseteq B$ if and only if $\mu_A(x) \leq \mu_B(x)$ and $\nu_A(x) \geq \nu_B(x)$ for all $x \in X$,

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

(c) $A^c = \{ \langle x, \nu_A(x), \mu_A(x) \rangle : x \in X\}$,

(d) $A \cup B = \{ \langle x, \mu_A(x) \vee \mu_B(x), \nu_A(x) \wedge \nu_B(x) \rangle : x \in X\}$,

(e) $A \cap B = \{ \langle x, \mu_A(x) \wedge \mu_B(x), \nu_A(x) \vee \nu_B(x) \rangle : x \in X\}$.

The intuitionistic fuzzy sets $0_\sim = \langle x, 0, 1 \rangle$ and $1_\sim = \langle x, 1, 0 \rangle$ are respectively the empty set and the whole set of X.

Definition 2.3: [2] An **intuitionistic fuzzy topology** (IFT) on X is a family τ of IFSs 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 $\{ G_i : i \in J \} \subseteq \tau$

In this case the pair (X, τ) is called the **intuitionistic fuzzy topological space** (IFTS) and any IFS in τ is known as an **intuitionistic fuzzy open set** (IFOS) in X. The complement A^c of an IFOS A in an IFTS (X, τ) is called an intuitionistic fuzzy closed set (IFCS) in X.

Definition 2.4: [6] An IFS $A = \langle x, \mu_A, \nu_A \rangle$ in an IFTS (X, τ) is said to be an

(i) ***intuitionistic fuzzy semi closed set*** (IFSCS) if int(cl(A)) ⊆ A,

(ii) ***intuitionistic fuzzy pre closed set*** (IFPCS) if cl(int(A)) ⊆ A,

(iii) ***intuitionistic fuzzy regular closed set***(IFRCS) if cl(int(A)) = A,

(iv) ***intuitionistic fuzzy α closed set*** (IFαCS) if cl(int(cl(A))) ⊆ A.

The respective complements of the above IFCSs are called their respective IFOSs.

Definition 2.5: [11]An IFS A of an IFTS (X, τ) is said to be an **intuitionistic fuzzy β^{**} generalized closed set** (IFβ^{**}GCS) if cl(int(cl(A))) ∩int(cl(int(A))) ⊆ U whenever A ⊆ U and U is an IFOS in (X, τ).

The complement A^c of an IFβ^{**}GCS A in an IFTS (X, τ) is called an **intuitionistic fuzzy β^{**} generalized open set** (IFβ^{**}GOS) in X.

Result 2.6: [11] Every IFCS, IFRCS, IFSCS, IFPCS, IFβCS, IFαCS, IFGCS is an IFβ^{**}GCS but the converses may not true in general.

Definition 2.7: [12]A mapping f : (X, τ) → (Y, σ) is called an **intuitionistic fuzzy β^{**} generalized continuous** (IFβ^{**}G continuous) **mapping** if f^{-1}(V) is an IFβ^{**}GCS in (X, τ) for every IFCS V of (Y, σ).

Definition 2.8: [14]An IFTS (X, τ) is an ***intuitionistic fuzzy* $\beta^{**}pT_{1/2}$**(IFβ**$pT_{1/2}$) ***space*** if every IFβ**GCS is an IFPCS in X.

Definition 2.9: [14]An IFTS (X, τ) is an ***intuitionistic fuzzy* $\beta^{**}gT_{1/2}$** (IFβ**$gT_{1/2}$) ***space*** if every IFβ**GCS is an IFGCS in X.

Definition 2.10: [9] 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 IFOSB in X such that $p_{(\alpha,\ \beta)}$ ∈ B ⊆ A.

Definition2.11:[5]Let$p_{(\alpha,\beta)}$beanIFPin(X,τ).AnIFSAofXiscalled an intuitionistic fuzzy β neighbourhood (IFβN) of $p_{(\alpha,\beta)}$ if there exists an IFβOS B in X such that $p_{(\alpha,\beta)}$∈ B ⊆A.

Definition 2.12 :[3]An IFS A is said to be an **intuitionistic fuzzy dense** (IFD) in another IFS B in an IFTS (X, τ), if cl(A) = B.

Definition 2.13: [13]Let A be an IFS in an IFTS (X, τ). Then the β^{**} generalized interior and β^{**} generalized closure of A are defined as

$\beta^{**}gint(A) = \cup \{ G / G$ is an IFβ^{**}GOS in X and $G \subseteq A \}$ and

$\beta^{**}g\,cl(A) = \cap \{ K / K$ is an IFβ^{**}GCS in X and $A \subseteq K \}$

It is to be noted that for any IFS A in (X, τ), we have $\beta^{**}g\,cl(A^c) = (\beta^{**}g\,int(A))^c$ and $\beta^{**}g\,int(A^c) = (\beta^{**}g\,cl(A))^c$.

Definition 2.14: [4]A mapping $f : (X, \tau) \to (Y, \sigma)$ is called an **intuitionistic fuzzy closed mapping** (IFCM) if f(V) is an IFCS in Y for every IFCS V in X.

Definition 2.15: [6] Let f be a mapping from an IFTS (X, τ) into an IFTS (Y, σ). Then f is said to be an

(i) ***intuitionistic fuzzy pre closed mapping*** (IFPCM) if f(A) is an IFPCS in Y for each IFCS A in X,

(ii) ***intuitionistic fuzzy α closed mapping*** (IFαCM) if f(A) is an IFαCS in Y for each IFCS A in X,

(iii) ***intuitionistic fuzzy semi closed mapping*** (IFSCM) if f(A) is an IFSCS in Y for each IFCS A in X.

3.Intuitionistic Fuzzy Almost β^{**} Generalized Closed Mappings

In this section we have introduced intuitionistic fuzzy almost β** generalized closed mappings, intuitionistic fuzzy almost β** generalized open mappings and investigated some of their properties.

Definition 3.1 :A mapping $f : (X, \tau) \to (Y, \sigma)$ is calledan **intuitionistic fuzzy almostβ** generalized** (IF almost β**G) **closed mapping** if f(V) is an IFβ**GCS in Y for every IFRCS V of X.

Example 3.2 : Let X = {a, b}, Y = {u, v} and $G_1 = \langle x, (0.3_a, 0.2_b), (0.7_a, 0.8_b)\rangle$, $G_2 = \langle y, (0.8_u, 0.6_v), (0.2_u, 0.4_v)\rangle$ and $G_3 = \langle y, (0.3_u, 0.4_v), (0.5_u, 0.6_v)\rangle$. Then $\tau = \{0_\sim, G_1, 1_\sim\}$ and $\sigma = \{0_\sim, G_2, G_3, 1_\sim\}$ are IFTs on X and Y respectively. Define a mapping $f : (X, \tau) \to (Y, \sigma)$ by f(a) = u and f(b) = v. Then f is an IF almost β**G closed mapping.

Proposition3.3 : Every IF closed mapping is an IF almostβ**Gclosed mapping but not conversely in general.

Proof: Let f : (X, τ) → (Y, σ) be an IF closed mapping. Let V be an IFRCS in X. Since every IFRCS is an IFCS in X, V is an IFCS in X. Then f(V) is an IFCS in Y, by hypothesis. Since every IFCS is an IFβ**GCS, f(V) is an IFβ**GCS in Y. Hence f is an IF almostβ**G closed mapping.

Example 3.4 : Let X = {a, b}, Y = {u, v} and $G_1 = \langle x, (0.3_a, 0.2_b), (0.7_a, 0.8_b)\rangle$, $G_2 = \langle y, (0.8_u, 0.6_v), (0.2_u, 0.4_v)\rangle$ and $G_3 = \langle y, (0.3_u, 0.4_v), (0.5_u, 0.6_v)\rangle$. Then $\tau = \{0_\sim, G_1, 1_\sim\}$ and $\sigma = \{0_\sim, G_2, G_3, 1_\sim\}$ are IFTs on X and Y respectively. Define a mapping f : (X, τ) → (Y, σ) by f(a) = u and f(b) = v. Then f is an IF almost β**G closed mapping but not an IF closed mapping, since $G_1^c = \langle x, (0.7_a, 0.8_b), (0.3_a, 0.2_b)\rangle$ is an IFCS in X but $f(G_1^c)$ is not an IFCS in Y, as $cl(f(G_1^c)) = 1_\sim \neq f(G_1^c)$.

Proposition 3.5 : Every IF semi closed mapping is an IF almost β**G closed mapping in (X, τ) but not conversely in general.

Proof : Let f : (X, τ) → (Y, σ) be an IF semi closed mapping. Let V be an IFRCS in X. Since every IFRCS is an IFCS in X, V is an IFCS in X. Then f(V) is an IFSCS in Y, by hypothesis. Since every IFSCS is an IFβ**GCS, f(V) is an IFβ**GCS in Y. Hence f is an IF almost β**Gclosed mapping.

Example 3.6 : Let X = {a, b}, Y = {u, v} and $G_1 = \langle x, (0.3_a, 0.2_b), (0.7_a, 0.8_b)\rangle$, $G_2 = \langle y, (0.8_u, 0.6_v), (0.2_u, 0.4_v)\rangle$ and $G_3 = \langle y, (0.3_u, 0.4_v), (0.5_u, 0.6_v)\rangle$. Then $\tau = \{0_\sim, G_1, 1_\sim\}$ and $\sigma = \{0_\sim, G_2, G_3, 1_\sim\}$ are IFTs on X and Y respectively. Define a mapping f : (X, τ) → (Y, σ) by f(a) = u and f(b) = v. Then f is an IF almost β**G closed mapping but not an IF semi closed mapping, since $G_1^c = \langle x, (0.7_a, 0.8_b), (0.3_a, 0.2_b)\rangle$ is an IFCS in X but $f(G_1^c)$ is not an IFSCS in Y, as $int(cl(f(G_1^c))) = 1_\sim \not\subseteq f(G_1^c)$.

Proposition3.7 : Every IF pre closed mapping is an IF almostβ**Gclosed mapping but not conversely in general.

Proof : Let f : (X, τ) → (Y, σ) be an IF pre closed mapping. Let V be an IFRCS in X. Since every IFRCS is an IFCS in X, V is an IFCS in X. Then f(V) is an IFPCS in Y, by hypothesis. Since every IFPCS is an IFβ**GCS, f(V) is an IFβ**GCS in Y. Hence f is an IF almost β**Gclosed mapping.

Example 3.8 : Let X = {a, b}, Y = {u, v} and $G_1 = \langle x, (0.5_a, 0.6_b), (0.5_a, 0.4_b)\rangle$, $G_2 = \langle x, (0.4_a, 0.3_b), (0.6_a, 0.7_b)\rangle$, and $G_3 = \langle y, (0.6_u, 0.6_v), (0.4_u, 0.4_v)\rangle$. Then $\tau = \{0_\sim, G_1, G_2, 1_\sim\}$ and $\sigma = \{0_\sim, G_3, 1_\sim\}$ are IFTs on X and Y respectively. Define a mapping f : (X, τ) → (Y, σ) by f(a) = u and f(b) = v. Then f is an IF almost β**G closed mapping, but not an IF pre closed since G_2^c is an IFCS in X but $f(G_2^c)$ is not an IFPCS in Y, as $cl(int(f(G_2^c))) = cl(G_3) = 1_\sim \not\subseteq f(G_2^c)$.

Proposition 3.9: Every IFα closed mapping is an IF almost β**Gclosed mapping but not conversely in general.

Proof: Let f : (X, τ) → (Y, σ) be an IFαclosed mapping. Let V be an IFRCS in X. Since every IFRCS is an IFCS in X, V is an IFCS in X. Then f(V) is an IFαCS in Y, by hypothesis. Since every IFαCS is an IFβ**GCS, f(V) is an IFβ**GCS in Y. Hence f is an IF almost β**Gclosed mapping.

Example 3.10: Let X = {a, b}, Y = {u, v} and $G_1 = \langle x, (0.3_a, 0.2_b), (0.7_a, 0.8_b)\rangle$, $G_2 = \langle y, (0.8_u, 0.6_v), (0.2_u, 0.4_v)\rangle$ and $G_3 = \langle y, (0.3_u, 0.4_v), (0.5_u, 0.6_v)\rangle$. Then $\tau = \{0_\sim, G_1, 1_\sim\}$ and $\sigma = \{0_\sim, G_2, G_3, 1_\sim\}$ are IFTs on X and Y respectively. Define a mapping f : (X, τ) → (Y, σ) by f(a) = u and f(b) = v. Then f is an IF almost β**G closed mapping but not an IFα closed mapping, since $G_1^c = \langle x, (0.7_a, 0.8_b), (0.3_a, 0.2_b)\rangle$ is an IFCS in X but $f(G_1^c)$ is not an IFαCS in Y, as $cl(int(cl(f(G_1^c)))) = 1_\sim \not\subseteq f(G_1^c)$.

Proposition3.11 : Every IFβ closed mapping is an IF almost β**G closed mapping but not conversely in general.

Proof : Let f : (X, τ) → (Y, σ) be an IFβclosed mapping. Let V be an IFRCS is an IFCS in X, V is an IFCS in X. Then f(V) is an IFβCS in Y by hypothesis. Since every IFβCS is an IFβ**GCS, f(V) is an IFβ**GCS in Y. Hence f is an IF almost β**G closed mapping.

Example 3.12: Let X = {a, b}, Y = {u, v} and $G_1 = \langle x, (0.4_a, 0.4_b), (0.6_a, 0.6_b)\rangle$, $G_2 = \langle x, (0.6_u, 0.6_v), (0.4_u, 0.4_v)\rangle$, $G_3 = \langle y, (0.5_u, 0.7_v), (0.5_u, 0.3_v)\rangle$ and $G_4 = \langle y, (0.5_u, 0.6_v), (0.5_u,$

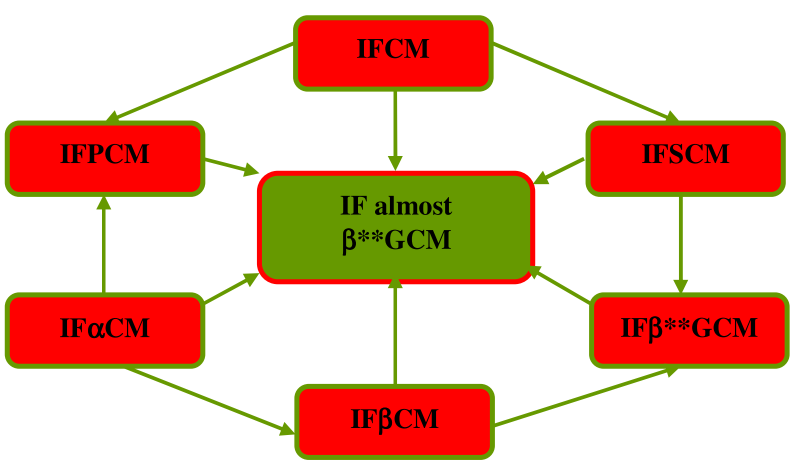
$0.4_v)\rangle$. Then $\tau = \{0_\sim, G_1, G_2, 1_\sim\}$ and $\sigma = \{0_\sim, G_3, G_4, 1_\sim\}$ are IFTs on X and Y respectively. Define a mapping $f : (X, \tau) \to (Y, \sigma)$ by $f(a) = u$ and $f(b) = v$. Then f is an IF almost β**G closed mapping but not an IFβ closed mapping, since $G_1^c = \langle x, (0.6_a, 0.6_b), (0.4_a, 0.4_b)\rangle$ is an IFCS in X but $f(G_1^c)$ is not an IFβCS in Y, as $int(cl(int(f(G_1^c)))) = 1_\sim \not\subseteq f(G_1^c)$.

Proposition3.13 : Every IFβ**G closed mapping is an IF almost β**G closed mapping but not conversely in general.

Proof : Let $f : (X, \tau) \to (Y, \sigma)$ be an IFβ**Gclosed mapping. Let V be an IFRCS is in X. Since every IFRCS is an IFCS in X, V is an IFCS in X. Then f(V) is an IFβ**GCS in Y by hypothesis. Hence f is an IF almost β**G closed mapping.

Example 3.14 : Let $X = \{a, b\}$, $Y = \{u, v\}$, $G_1 = \langle x, (0.2_a, 0.2_b), (0.5_a, 0.8_b)\rangle$, $G_2 = \langle x, (0.2_u, 0.2_v), (0.5_u, 0.6_v)\rangle$ and $G_3 = \langle y, (0.5_u, 0.8_v), (0.2_u, 0.2_v)\rangle$. Then $\tau = \{0_\sim, G_1, G_2, 1_\sim\}$ and $\sigma = \{0_\sim, G_3, 1_\sim\}$ are IFTs on X and Y respectively. Define a mapping $f : (X, \tau) \to (Y, \sigma)$ by $f(a) = u$ and $f(b) = v$. Then f is an IF almost β**G closed mapping but not an IFβ**G closed mapping, since $G_1^c = \langle x, (0.5_a, 0.8_b), (0.2_a, 0.2_b)\rangle$ is an IFCS in X but $f(G_1^c)$ is not an IFβ**GCS in Y, as $f(G_1^c) \subseteq G_3$ whereas $int(cl(int(f(G_1^c)))) \cap cl(int(cl(f(G_1^c)))) = 1_\sim \not\subseteq G_3$.

The relation between various types of intuitionistic fuzzy closed mappings is given in the following diagram. In this diagram 'CM' means closed mappings. The reverse implications are not true in general in the below diagram.



Definition 3.15:A mapping $f : (X, \tau) \to (Y, \sigma)$ is said to be an **intuitionistic fuzzy almost β** generalized** (IF almost β**G) **open mapping** if f(A) is an IFβ**GOS in Y for each IFROS A in X.

Proposition3.16 :A bijective mapping $f : (X, \tau) \to (Y, \sigma)$ is an IF almost β**Gclosed mapping if and only if the inverse image of each IFROS in X is an IFβ**GOSin Y.

Proof : Necessity : Let A be an IFROS in X. This implies A^c is an IFRCS in X. Then $f(A^c)$ is an IFβ**GCS in Y, by hypothesis.Since $f(A^c) = (f(A))^c$, for bijective mapping f(A) is an IFβ**GOS in Y.

Sufficiency : Let A be an IFRCS in X. Then A^c is an IFROS in X. By hypothesis $f(A^c)$ is IFβ**GOS in Y. Therefore f(A) is an IFβ**GCS in Y. Hence f is an IF almost β**G closed mapping.

Proposition3.17 : Let $p_{(\alpha, \beta)}$ be an IFP in X. A mapping $f : X \to Y$ is an IF almost β**G open mapping if for every IFOS A in X with $f^{-1}(p_{(\alpha,\beta)}) \in A$, there exists an IFOS B in Y with $p_{(\alpha, \beta)} \in B$ such that f(A) is IFD in B.

Proof : Let A be an IFROS in X. Then A is an IFOS in X. Let $f^{-1}(p_{(\alpha,\beta)}) \in A$, then there exists an IFOS B in Y such that $p_{(\alpha,\beta)} \in B$ and cl(f(A)) = B. Since B is an IFOS, cl(f(A)) = B is also an IFOS in Y. Therefore int(cl(f(A))) = cl(f(A)). Now $f(A) \subseteq cl(f(A)) = int(cl(f(A))) \subseteq cl(int(cl(f(A))))$. This implies f(A) is an IFβOS in Y and hence an IFβ^{**}GOS in Y. Thus f is an IF almost β^{**}G open mapping.

Proposition3.18: Let $f : X \to Y$ be a mapping. Then f is an IF almost β^{**}G open mapping if for each IFP $p_{(\alpha, \beta)} \in Y$ and for each IFβOS B in X such that $f^{-1}(p_{(\alpha, \beta)}) \in B$, βcl(f(B)) is an IFβN of $p_{(\alpha, \beta)} \in Y$.

Proof : Let $p_{(\alpha, \beta)} \in Y$ and let A be an IFROS in X. Then A is an IFβOS in X. By hypothesis $f^{-1}(p_{(\alpha, \beta)}) \in A$, that is $p_{(\alpha, \beta)}) \in f(A)$ inY and βcl(f(A)) is an IFβN of $p_{(\alpha, \beta)}$ in Y. Therefore there exists an IFβOS B in Y such that $p_{(\alpha, \beta)} \in B \subseteq \beta cl(f(A))$. We have $p_{(\alpha, \beta)} \in f(A) \subseteq \beta cl(f(A))$. Now $B = \bigcup\{p_{(\alpha, \beta)} / p_{(\alpha, \beta)} \in B\} = f(A)$. Therefore f(A) is an IFβOS in Y and hence an IFβ**GOS in Y. Thus f is an IF almost β**G open mapping.

Proposition3.19 : Let f : X → Y be a mapping. If f is an IF almost β**G closed mapping, then β**gcl(f(A)) ⊆ f(cl(A)) for every IFβOS A in X.

Proof : Let A be an IFβOS in X. Then cl(A) is an IFRCS in X. By hypothesis f(cl(A)) is an IFβ**GCS in Y. Then β**gcl(f(cl(A))) = f(cl(A)). Now β**gcl(f(A)) ⊆β**gcl(f(cl(A))) = f(cl(A)). That is β**gcl(f(A)) ⊆ f(cl(A)).

Corollary 3.20 : Let f : X → Y be a mapping. If f is an IF almost β**G closed mapping, then β**gcl(f(A))⊆ f(cl(A)) for every IFSOS A in X.

Proof : Since every IFSOS is an IFβOS, the proof directly follows from the Proposition 3.19.

Corollary3.21 : Let f : X →Y be a mapping. If f is an IF almost β**G closed mapping, then β**gcl(f(A)) ⊆ f(cl(A)) for every IFPOS A in X.

Proof : Since every IFPOS is an IFβOS, the proof directly follows from the Proposition 3.19.

Proposition 3.22 : Let f : (X, τ) → (Y, σ) be a mapping. If f is an IF almost β**G closed mapping, then β**gcl(f(A)) ⊆ f(cl(βint(A))) for every IFβOS A in X.

Proof : Let A be an IFβOS in X. Therefore βint(A) = A and cl(A) is an IFRCS in X. By hypothesis, f(cl(A)) is an IFβ**GCS in Y. Then β**gcl(f(A)) ⊆β**gcl(f(cl(A))) = f(cl(A)) = f(cl(βin(A))).

Corollary 3.23 : Let f : X → Y be a mapping. If f is an IF almost β**G closed mapping, then β**gcl(f(A)) ⊆ f(cl(βint(A))) for every IFSOS A in X.

Proof : Since every IFSOS is an IFβOS, the proof directly follows from the Proposition 3.22.

Corollary 3.24 : Let f : X → Y be a mapping, If f is an IF almost β**G closed mapping, then β**gcl(f(A)) ⊆ f(cl(βint(A))) for every IFPOS A in X.

Proof : Since every IFPOS is an IFβOS, the proof directly follows from the Proposition 3.22.

Proposition 3.25 : Let f : (X, τ) → (Y, σ) be a bijective mapping. Then the following are equivalent.

(i) f is an IF almost β**G open mapping.

(ii) f is an IF almost β**G closed mapping.

(iii) f^{-1} is an IF almost β**G continuous mapping.

Proof :(i) ⇔ (ii) is obvious as for a bijective mapping, $f(A^c) = f(A)^c$.

(ii) ⇒ (iii) Let A ⊆ X be an IFRCS. Then by hypothesis, f(A) is an IFβ**GCS in Y. That is $(f^{-1})^{-1}$ (A) is an IFβ**GCS in Y. This implies f^{-1} is an IF almost β**G continuous mapping.

(iii) ⇒ (ii) Let A ⊆ X be an IFRCS. Then by hypothesis, $(f^{-1})^{-1}$ (A) is an IFβ**GCS in Y. That is f(A) is an IFβ**GCS in Y. Hence f is an IF almost β**G closed mapping.

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