Advances and Applications in Mathematical Sciences
Volume 18, Issue 11, September 2019, Pages 1531-1541

ON $Ig^{*}b$- CLOSED SETS IN INTUITIONISTIC TOPOLOGICAL SPACES

P. SATHISHMOHAN, V. RAJENDRAN and M. GOMATHI

Department of Mathematics,
Kongunadu Arts and Science College (Autonomous)
Coimbatore-641029, India

Abstract

Coker introduced the concept of intuitionistic sets and intuitionistic points. He also introduced the concept of intuitionistic topological spaces and investigated some basic properties of closed sets in intuitionistic topological spaces. The purpose of this paper is to introduce and study the concept of intuitionistic $Ig^{*}b$- closed sets in intuitionistic topological spaces and study its relation with some of existing intuitionistic closed sets.

1. Introduction

The concept of intuitionistic sets in topological spaces was first introduced by Coker [1]. He has studied some fundamental topological properties on intuitionistic sets. Gnanambal Ilango [2] has given some results in intuitionistic sets and intuitionistic generalized pre-regular closed sets in intuitionistic topological spaces. Zinah [7] introduce the concept of generalized b star closed sets and studied their most fundamental properties in topological spaces. Later, In 2017, Pavulin rani [4] introduced the concept of generalized b-closed sets as a generalization of vague topological spaces.

The purpose of this paper is to develop generalized star b-closed sets in intuitionistic topological spaces and to discuss some properties related to $g^{*}b$- closed sets in intuitionistic topological spaces.

2010 Mathematics Subject Classification: 54A05.
Keywords: $Ig^{*}b$- closed and $Ig^{*}b$- open.
Received July 12, 2019; Accepted September 26, 2019

2. Preliminaries

Definition 2.1 [1]**.** Let X be a non empty set. An intuitionistic set (IS for short) A is an object having the form $A = \langle X, A_1, A_2 \rangle$ where A_1, A_2 are subsets of X satisfying $A_1 \cap A_2 = \varphi$. The set A_1 is called the set of members of A, while A_2 is called the set of non members of A.

Definition 2.2. [1] Let X be a non empty set and let A, B are intuitionistic sets in the form $A = \langle X, A_1, A_2 \rangle$, $B = \langle X, B_1, B_2 \rangle$ respectively. Then

(a) $A \subseteq B$ iff $A_1 \subseteq B_2$ and $A_2 \supseteq B_2$

(b) $A = B$ iff $A \subseteq B$ and $B \subseteq A$

(c) $\overline{A} = \langle X, A_2, A_1 \rangle$

(d) $[\ ] A = \langle X, A_1, (A_1)^c \rangle$

(e) $A - B = A \cap \overline{B}$

(f) $\varphi = \langle X, \varphi, X \rangle$, $X = \langle X, X, \varphi \rangle$

(g) $A \cup B = \langle X, A_1 \cup B_1 \ A_2 \cap B_2 \rangle$

(h) $A \cap B = \langle X, A_1 \cap B_1 \ A_2 \cup B_2 \rangle$.

Definition 2.3. [1] An intuitionistic topology is (for short IT) on a non empty set X is a family τ of IS's in X satisfying the following axioms.

(1) $\varphi, X \in \tau$

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

(3) $\cup G_a \in \tau$ for any arbitrary family $\{G_i : G_a / a \in J\} \subseteq \tau$ where (X, τ) is called an intuitionistic topological space (for short $ITS(X)$) and any intuitionistic set is called an intuitionistic open set (for short IOS) in X. The complement A^C of an IOS A is called an intuitionistic closed set (for short ICS) in X.

Definition 2.4. [1] Let (X, τ) be an intuitionistic topological space (for short $ITS(X)$) and $A = \langle X, A_1, A_2 \rangle$ be an IS in X. Then the interior and closure of A are defined by

(1) $Icl(A) = \cap K : K$ is an ICS in X and $A \subseteq K\}$

(2) $I \operatorname{int}(A) = \cup\{G : G$ is an IOS in X and $G \subseteq A\}$.

It can be shown that $Icl(A)$ is an ICS and $I \operatorname{int}(A)$ is an IOS in X and A is an ICS in X iff $Icl(A) = A$ and is an IOS in X iff $I \operatorname{int}(A) = A$.

Definition 2.5. [1] Let X be a non empty set and $p \in X$. Then the IS P defined by $P = \langle X, \{P\}, \{P\}^C \rangle$ is called an intuitionistic point (IP for short) in X. The intuitionistic point P is said to be contained in $A = \langle X, A_1, A_2 \rangle$ (i.e., $P \in A$) if and only if $p \in A_1$.

Definition 2.6. [1] Let (X, τ) be an $ITS(X)$. An intuitionistic set A of X is said to be

(1) Intuitionistic semi-open if $A \subseteq Icl(I \operatorname{int}(A))$.

(2) Intuitionistic pre-open if $A \subseteq I \operatorname{int}(Icl(A))$.

(3) Intuitionistic regular-open if $A = I \operatorname{int}(Icl(A))$.

(4) Intuitionistic α-open if $A \subseteq I \operatorname{int}(Icl(I \operatorname{int}(A)))$.

(5) Intuitionistic β-open if $A \subseteq Icl(I \operatorname{int}(Icl(A)))$.

(6) Intuitionistic b-open if $A \subseteq I \operatorname{int}(Icl(A)). \cup Icl(I \operatorname{int}(A))$.

The family of all intuitionistic semi-open, intuitionistic pre-open, intuitionistic regular-open, intuitionistic α-open, intuitionistic β-open and intuitionistic b-open sets of (X, τ) are denoted by ISOS, IPOS, IROS, IαOS, IβOS and IbOS respectively.

Definition 2.7. [2] Let a subset A of a intuitionistic topological spaces (X, τ) is called a intuitionistic generalized b-closed set (briefly Igb- closed) if $Ibcl(A) \subseteq U$ whenever $A \subseteq U$ and U is I-open in X.

Definition 2.8. [6] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic generalized star-closed set (briefly Ig^*-closed) if $Icl(A) \subseteq U$ whenever $A \subseteq U$ and U is Ig-open in X.

Definition 2.9. [6] Let a subset A of intuitionistic topological spaces (X, τ) is called a intuitionistic regular-generalized closed set (briefly Irg-closed) if $Icl(A) \subseteq U$ whenever $A \subseteq U$ and U is Ir-open in X.

Definition 2.10. [3] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic generalized α-closed set (briefly Igα-closed) if $I\alpha cl(A) \subseteq U$ whenever $A \subseteq U$ and U is I-open in X.

Definition 2.11. [6] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic generalized pre regular-closed set (briefly $Igpr$-closed) if $Ipcl\,(A) \subseteq U$ whenever $A \subseteq U$ and U is Ir-open in X.

Definition 2.12. [5] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic generalized pre-closed set (briefly Igp-closed) if $Ipcl(A) \subseteq U$ whenever $A \subseteq U$ and U is I-open in X.

Definition 2.13. [3] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic semi-generalized closed set (briefly Isg-closed) if $Iscl\,(A) \subseteq U$ whenever $A \subseteq U$ and U is Is-open in X.

Definition 2.14. [3] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic generalized semi regular-closed set (briefly $Igsr$-closed) if $Iscl\,(A) \subseteq U$ whenever $A \subseteq U$ and U is Ir-open in X.

Definition 2.15. [3] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic generalized semi-closed set (briefly Igs-closed) if $Iscl\,(A) \subseteq U$ whenever $A \subseteq U$ and U is I-open in X.

Definition 2.16. [5] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic generalized pre semi-closed set (briefly $Igps$-closed) if $Ipcl \subseteq U$ whenever $A \subseteq U$ and U is Is-open in X.

Definition 2.17. [6] Let a subset A of intuitionistic topological spaces (X, τ) is called an intuitionistic w-closed set (briefly Iw-closed) if $Icl\,(A) \subseteq U$ whenever $A \subseteq U$ and U is Is-open in X.

3. Intuitionistic g^*b- closed Sets

In this section, we define and study the concept of Intuitionistic generalized star b-closed (briefly, Ig^*b-closed) sets in intuitionistic topological spaces and obtain some of its properties.

Definition 3.1. A subset A of an intuitionistic topological space (X, τ) is called Intuitionistic generalized star b-closed set (briefly, Ig^*b-closed set) if $Ibcl(A) \subseteq U$ whenever $A \subseteq U$ and U is Ig-open.

Theorem 3.2. *Every intuitionistic closed set is* Ig^*b-*closed but not conversely*.

Proof. Let A be an I-closed set in an intuitionistic topological space (X, τ) and $A \subseteq U$, where U is Ig-open. Since A is I-closed, $Icl(A) = A \subseteq U$. But $Ibcl(A) \subseteq Icl(A) \subseteq U$. Therefore $Ibcl(A) \subseteq U$ and hence A is Ig^*b-closed.

Example 3.3. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5\}$, where $A_1 = \langle X, \{b\}, \{a\}\rangle$, $A_2 = \langle X, \{a\}, \{b\}\rangle$, $A_3 = \langle X, \{a\}, \{b, c\}\rangle$, $A_4 = \langle X, \varphi, \{a, b\}\rangle$, $A_5 = \langle X, \{a, b\}, \varphi\rangle$. Then the intuitionistic subset $A = \langle X, \{c, a\}, \{b\}\rangle$ is an Ig^*b-closed set in (X, τ) but not an I-closed set.

Theorem 3.4. *Every* Ig^*b-*closed set is Igp-closed but not conversely*.

Proof. Let A be an Ig^*b-closed set in intuitionistic topological space (X, τ). Let $A \subseteq U$ and U is Ig-open in (X, τ). Since every I-open is Ig-open and A is Ig^*b-closed, that is $Ipcl(A) \subseteq U$. Also $Ipcl(A) \subseteq Ibcl(A) \subseteq U$, where U is Ig-open in (X, τ). Hence $Ipcl(A) \subseteq U$. Therefore A is Igp-closed.

Example 3.5. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle X, \{b\}, \{a\}$, $A_3 = \langle X, \{a\}, \varphi\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \varphi, \{a, b\}\rangle$, $A_6 = \langle X, \varphi, \{a\}\rangle$.

Then the intuitionistic subset $A = \langle X, \varphi, \{b\}\rangle$ is an *Igp*-closed set in (X, τ) but not an $Ig^{*}b$- closed set.

Theorem 3.6. *Every $Ig^{*}b$- closed set is Igpr-closed but not conversely.*

Proof. Let A be an $Ig^{*}b$- closed in intuitionistic topological space (X, τ). Let $A \subseteq U$ and U is *Ig*-open in (X, τ). Since every *Ir*-open is *Ig*-open and A is $Ig^{*}b$- closed, that is $Ibcl(A) \subseteq U$. Also $Ipcl(A) \subseteq Ibcl(A) \subseteq U$ where U is *Ig*-open in (X, τ). Hence $Ipcl(A) \subseteq U$. Therefore A is *Igpr*-closed.

Example 3.7. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6, A_7\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$ $A_3 = \langle X, \{b\}, \varphi\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \{a\}, \varphi\rangle$, $A_6 = \langle X, \varphi, \{a, b\}\rangle$, $A_7 = \langle X, \varphi, \{b\}\rangle$. Then the intuitionistic subset $A = \langle X, \{c, a\}, \varphi\rangle$ is an *Igpr*-closed set in (X, τ) but not an $Ig^{*}b$- closed set.

Theorem 3.8. *Every $Ig^{*}b$- closed set is Igsr-closed but not conversely.*

Proof. Let $A \subseteq X$ be an $Ig^{*}b$- closed in intuitionistic topological space (X, τ) and $A \subseteq U$, where U is an *Ir*-open. Since every *Ir*-open is *I*-open and *Ig*-open and A is $Ig^{*}b$- closed, that is $Ibcl(A) \subseteq U$. Also $Iscl(A) \subseteq Ibcl(A) \subseteq U$, where U is Ig-open in (X, τ), thus $Iscl(A) \subseteq U$. Hence A is *Igsr*-closed.

Example 3.9. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle, X, \{a\}, A_2 = \langle \{b, c\}, \varphi\rangle$, $A_3 = \langle X, \{b, c\}, \varphi\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \varphi, \{a, b\}\rangle$, $A_6 = \langle X, \varphi, \{b\}\rangle$. Then the intuitionistic subset $A = \langle X, \{b, c\}, \varphi\rangle$ is an *Igsr*-closed set in (X, τ) but not an $Ig^{*}b$- closed set.

Theorem 3.10. *Every Iw-closed set is $Ig^{*}b$- closed but not conversely.*

Proof. Let $A \subseteq X$ be an *Iw*-closed set in intuitionistic topological space (X, τ). Then $Icl(A) \subseteq U$ whenever $A \subseteq U$ and U be Is-open. Since every *Is*-

open is Ig-open and A is Iw-closed, then $Ibcl(A) \subseteq Icl(A) \subseteq U$. Hence A is Ig^*b- closed.

Example 3.11. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$, $A_3 = \langle X, \varphi, \{a, b\}\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$. Then the intuitionistic subset $A = \langle X, \varphi, \{c\}, \varphi\rangle$ is an Ig^*b- closed set in (X, τ) but not an Iw-closed set.

Theorem 3.12. *Every Ig^*- closed set is Ig^*b- closed but not conversely.*

Proof. Let $A \subseteq X$ be an Ig^*- closed set in intuitionistic topological space (X, τ) and then $Icl(A) \subseteq U$ whenever $A \subseteq U$ where U is an Ig-open. Since A is Ig^*- closed. Then $Icl(A) \subseteq U$ which implies $Ibcl(A) \subseteq Icl(A) \subseteq U$. Hence A is Ig^*b- closed.

Example 3.13. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$, $A_3 = \langle X, \varphi, \{a\}\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \{a\}, \varphi\rangle$, $A_6 = \langle X, \varphi, \{a, b\}\rangle$. Then the intuitionistic subset $A = \langle X, \{b\}, \{c\}\rangle$ is an Ig^*b- closed set in (X, τ) but not an Ig^*- closed set.

Theorem 3.14. *Every Is-closed set is Ig^*b- closed but not conversely.*

Proof. Let A be an Is-closed set in an intuitionistic topological space (X, τ) and $A \subseteq U$, where U is Ig-open. Since A is Is-closed, $Iscl(A) = A \subseteq U$. But $Ibcl(A) \subseteq Iscl(A) \subseteq U$. Therefore $Ibcl(A) \subseteq U$ and hence A is Ig^*b- closed.

Example 3.15. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$, $A_3 = \langle X, \varphi, \{b\}\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \{b\}, \varphi\rangle$, $A_6 = \langle X, \varphi, \{a, b\}\rangle$. Then the intuitionistic set $A = \langle X, \{a\}, \{c\}\rangle$ is an Ig^*b- closed set in (X, τ) but not an intuitionistic semi-closed set.

Theorem 3.16. *Every Ir-closed set is* Ig^*b*- closed but not conversely.*

Proof. Let A be an Ir-closed set in an intuitionistic topological space (X, τ) and $A \subseteq U$, where U is Ig-open.

Since A is Ir-closed, $Ircl(A) = A \subseteq U$. But $Ibcl(A) \subseteq Ircl(A) \subseteq U$. Therefore $Ibcl(A) \subseteq U$ and hence A is Ig^*b- closed.

Example 3.17. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8, A_9\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$, $A_3 = \langle X, \varphi, \varphi\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \{b\}, \varphi\rangle$, $A_6 = \langle X, \{a\}, \varphi\rangle$, $A_7 = \langle X, \varphi, \{a, b\}\rangle$, $A_8 = \langle X, \varphi, \{a\}\rangle$, $A_9 = \langle X, \varphi, \{b\}\rangle$. Then the intuitionistic subset $A = \langle X, \{a, b\}, \{c\}\rangle$ is an Ig^*b- closed set in (X, τ) but not Ir-closed set.

Theorem 3.18. *Every* $I\alpha$*-closed set is* Ig^*b*- closed but not conversely.*

Proof. Let A be an $I\alpha$-closed set in an intuitionistic topological space (X, τ) and $A \subseteq U$, where U is Ig-open.

Since A is $I\alpha$-closed, $I\alpha cl(A) = A \subseteq U$. But $Ibcl(A) \subseteq I\alpha cl(A) \subseteq U$. Therefore $Ibcl(A) \subseteq U$ and hence A is Ig^*b- closed.

Example 3.19. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$, $A_3 = \langle X, \{c, a\}, \varphi\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \varphi, \{a, b\}\rangle$, $A_6 = \langle X, \varphi, \{a\}\rangle$. Then the intuitionistic subset $A = \langle X, \{b, c\}, \{a\}\rangle$ is an Ig^*b- closed set in (X, τ) but not an $I\alpha$-closed set.

Remark 3.20. Union of any two Ig^*b- closed set is Ig^*b- closed.

Proof. Let A and B are any two Ig^*b- closed set. Let $A \cup B \subseteq U$, where U is Ig-open. Since A and B are Ig^*b- closed sets. Therefore $Ibcl(A) \subseteq Ibcl(B) \subseteq U$, thus $Ibcl(A \cup B) \subseteq U$. Hence $A \cup B$ is Ig^*b- closed set.

Example 3.21. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$, $A_3 = \langle X, \varphi, \{a\}\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \{a\}, \varphi\rangle$, $A_6 = \langle X, \varphi, \{a, b\}\rangle$. Then the intuitionistic subsets $\langle X, \{a\}, \varphi\rangle$ and $\langle X, \varphi, \{a\}\rangle$ are Ig^*b- closed and their union is also Ig^*b- closed.

Remark 3.22. Intersection of any two Ig^*b- closed set is Ig^*b- closed which is seen from the following example.

Example 3.23. Let $X = \{a, b, c\}$ and the family $\tau = \{\varphi, X, A_1, A_2, A_3, A_4, A_5, A_6\}$, where $A_1 = \langle X, \{a\}, \{b\}\rangle$, $A_2 = \langle X, \{b\}, \{a\}\rangle$, $A_3 = \langle X, \{a\}, \varphi\rangle$, $A_4 = \langle X, \{a, b\}, \varphi\rangle$, $A_5 = \langle X, \varphi, \{a, b\}\rangle$, $A_6 = \langle X, \varphi, \{a\}\rangle$. Then the intuitionistic subsets $\langle X, \{a\}, \{b\}\rangle$ and $\langle X, \{b\}, \{a\}\rangle$ are Ig^*b- closed and their intersection is also Ig^*b- closed.

Remark 3.24. In an intuitionistic topological space (X, τ), if $Ibcl(A) = A$ then A is Ig^*b- closed.

Proposition 3.25. *If* $IbO(X) \neq IbC(X)$ *then* $Ig^*b(X) \neq P(X)$ *where* $P(X)$ *is the power set of the intuitionistic topological space X.*

Theorem 3.26. *Let A be an* Ig^*b- *closed set of an intuitionistic topological space* (X, τ) *and* $A \subseteq B \subseteq Ibcl(A)$ *then B is* Ig^*b- *closed in X.*

Proof. Let A be an Ig^*b- closed set of an intuitionistic topological space (X, τ) and $A \subseteq B \subseteq Ibcl(A)$. Let U be an Ig-open set such that $B \subseteq U$. Then $A \subseteq U$ and since A is Ig^*b- closed, we have $Ibcl(A) \subseteq U$. Now $B \subseteq Ibcl(A)$ which implies $Ibcl(B) \subseteq Ibcl(Ibcl(A)) = Ibcl(A) \subseteq U$. Hence B is Ig^*b- closed in X.

Theorem 3.27. *Let A be an intuitionistic subset of an intuitionistic topological space* (X, τ) *then A is* Ig^*b- *open if and only if* $U \subseteq Ib\operatorname{int}(A)$ *whenever U is I-open and* $U \subseteq A$.

Proof. Necessity: Let A be $Ig^{*}b$- open in X and U be I-closed in X such that $U \subseteq A$, then UC is I-open in X such that $U^{c} \subseteq A^{c}$, A^{c} is $Ig^{*}b$- closed so $Ibcl(A^{c}) \subseteq U^{c}$ but $Ibcl(A^{c}) = (Ib\operatorname{int}(A))^{c} \subseteq U^{c}$ implies $I \subseteq Ib\operatorname{int}(A)$.

Sufficiency : Let F be an I-open in X Such that $A^{c} \subseteq F$. Then F^{c} is I-closed in X and $F^{c} \subseteq A$.

To Prove: A^{c} is $Ig^{*}b$- closed.

Now $F^{c} \subseteq Ib\operatorname{int}(A)$ which implies $Ibcl(A^{c}) = (Ib\operatorname{int}(A))^{c} \subseteq F$. Hence A^{c} is $Ig^{*}b$- closed which implies A is $Ig^{*}b$- open in X.

Theorem 3.28. *Let A be an intuitionistic generalized open set of an intuitionistic topological space (X, τ) and $Ib\operatorname{int}(A) \subseteq B \subseteq A$ then B is $Ig^{*}b$- open.*

Proof. Now $Ib\operatorname{int}(A) \subseteq B \subseteq A$. Since $(Ib\operatorname{int}(A))^{c} = Ibcl(A^{c})$, $A^{c} \subseteq B^{c} \subseteq Ibcl(A^{c})$ then A^{c} is $Ig^{*}b$- closed, B^{c} is also $Ig^{*}b$- closed then obviously B is $Ig^{*}b$- open.

Theorem 3.29. *A subset A in an intuitionistic topological space (X, τ) is an Ig-open if and only if $\subset Ibcl(A)$.*

Proof. Necessity: Let A be Ig-open, then there exist an I-open set B, such that $B \subset A \subset Ibcl(B)$, but $B \subset Ibcl(A)$ and thus $Ibcl(B) \subset Ibcl(A)$. Hence $A \subset Ibcl(B) \subset Ibcl(A)$.

Sufficiency: Let $A \subset Ibcl(A)$ we have $Ibcl(A) \subset A$. then for $Ibcl(A) \subset A \subset Ibcl(A)$ taking $U = Ibcl(A)$, it becomes $U \subseteq A \subseteq Ibcl(U)$ this implies A is Ig-open.

Theorem 3.30. *Let A be Ig-open in the intuitionistic topological space (X, τ) and suppose $A \subset B \subset Ibcl(A)$, then B is Ig-open.*

Proof There exist an I-open set U such that $U \subseteq A \subseteq Ibcl(U)$. Since $U \subset Ibcl(A) \subset Ibcl(U)$ and thus $\subseteq Ibcl(U)$. Hence $U \subset B \subset Ibcl(U)$ and B is Ig-open.

Theorem 3.31. *Let A is* Ig^*b- *closed if and only if there exists an I-closed set F such that* $I\,\text{int}\,(F) \subseteq A \subseteq F$.

Proof. Let A be Ig^*b- closed, then $Ibcl\,(A) \subseteq A$. Let $Icl\,(A) = B$. Then B is I-closed. Now $I\,\text{int}\,(B) \subseteq A \subseteq B$. Thus if A is an Ig^*b- closed there exist an I-closed set F such that $I\,\text{int}\,(F) \subseteq A \subseteq F$. conversely, let F be an I-closed set such that $I\,\text{int}\,(F) \subseteq A \subseteq F$. Since $A \subseteq F \Rightarrow Icl(A) \subseteq Icl(F) \Rightarrow Ibcl(A) \subseteq Ibcl\,(F) = I\,\text{int}\,(F)$, because F is intuitionistic closed, $Icl\,(F) = F \subseteq A \Rightarrow A$ is an Ig^*b- closed set.

References

[1] D. Coker, A note on intuitionistic sets and intuitionistic points, Turkish Journal of Mathematics 20(3) (1996), 343-351.

[2] Gnanambal illango and S. Selvanayaki, Generalized preregular closed sets in intuitionistic topological spaces, International Journal of Mathematical Archive-5(4) (2014), 30-36.

[3] R. Janani and K. Mohana, On generalized semi closed sets in intuitionistic topological spaces, International Journal of Innovations Research in Technology 4(9) (2018), 455-460.

[4] S. Pavulin Rani and M. Trinita Pricilla, Generalized b-closed sets in vague topological spaces, International Journal of Applied Research 3(7) (2017), 519-525.

[5] K. Ramesh and T. Nithyaannapoorni, On generalized presemi closed sets in intuitionistic topological spaces, International Journal of Advanced Research Trends in Engineering and Technology (IJARTET), 5(12) (2018), 964-968.

[6] Taha H. Jassim, Samer R. Yaseen and Luma S. Abdual Baqi, Some Generalized Sets and Mappings in Intuitionistic Topological Spaces, Journal of AL-Qadisiyah for Computer Science and Mathematics 7(2) (2015), 80-96.

[7] T. Zinah and T. Alhawez, On generalized b∗-closed sets in topological spaces, Ibn Al-Haitham Journal for Pure and Applied Science 28(3) (02015), 204-213.