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On Soft B- Open Sets In Soft Bitopological Space

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Abstract
In this paper, we introduce(1,2)*- softb- open sets and (1,2)*- soft b –closed sets in soft bitopological space and exhibit the properties of(1,2)*-softb- open sets. Then we discuss the relation with (1,2)*-soft regular- open, (1,2)*- soft preopen, (1,2)*-soft semi open, (1,2)*- soft α - open, (1,2)*-softβ - open in soft bitopological space. Also we study about(1,2)*- soft b-interior, (1,2)*- soft b- closurein soft bitopological space and analyze the relation between other functions.

Keywords: (1,2)*- softb- open set, (1,2)*- soft b –closed set, (1,2)*-soft regular- open, (1,2)*- soft pre open, (1,2)*-soft semi open, (1,2)*- soft α - open, (1,2)*-softβ -open, (1,2)*- soft b-interior, (1,2)*- soft b- closure.
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Introduction

In the year 1999, Russian researcher Molodtsov [7], initiated the concept of soft sets as a new mathematical tool to deal with uncertainties while modelling problems in computer science, engineering physics, economics, social sciences and medical sciences. In 2003, Maji, Biswas and Roy [8], studied the theory of soft sets. They discussed the basic soft sets definition with examples. In 2011, Muhammad Shabir and Munazza Naz [12] defined the theory of soft topological over an initial universe with a fixed set of parameters. N. Cagmen and S. Karatas [5] introduced a topology on a soft set called "soft topology" and presented the foundations of the theory of soft topological spaces. In 1963, J.C. Kelly [6], first intiated the concept of bitopological spaces. He defined a bitopological space (X, τ_1,τ_2) to be a set X with two topologies τ_1 and τ_2 on X and intiated the systematic study of bitopological spaces. In 2014, Basavaraj M. Ittanagi [2] introduced the concept of Soft bitopological spaces. D. Andrijevic [1] introduced b- open sets which are some of the weak forms of open sets.

2. Preliminaries

In this section, we have presented some of the basic definitions and results of soft theory, soft topological space, bitopological spaces and soft bitopological space to use in the sequel. Throughout this paper, X is an initial universe, E is the set of parameters, P(X) is the power set of X, and A$\subseteq$ X

Definition 2.1 : [4] A soft set F_A on the universe X is defined by the set of ordered pairs F_A = { (x, f_A(x)) : x$\in$E}, where f_A : E $\rightarrow$ P(X) such that $f_A(x) = \phi$ if x $\notin$ A. Here f_A is called approximate function of the soft set F_A. The value of f_A (x) may arbitrary, some of them maybe empty, some may have non empty intersection. The set of all soft sets over X will be denoted by S(X).

Example 2.2:[4]Suppose that there are six houses in the universe X ={h_1, h_2,h_3,h_4,h_5,h_6}under consideration, and that E = { e_1,e_2,e_3,e_4,e_5} is a set of decision parameters. The e_i (i = 1, 2, 3, 4,5) stand for the parameters "expensive", "beautiful", "wooden", "cheap", and in "green surroundings" respectively. Consider the mapping f_A given by "houses(.)", where (.) is to be filled by one of the parameters $e_i \in$ E. For instance, $f_A(e_1)$ means " houses (expensive)",and its functional value is the set { h $\in$X: h is an expensive house}.

Suppose that $A = \{e_1, e_2, e_4\} \subseteq E$ and $f_A(e_1) = \{h_2, h_4\}$, $f_A(e_2) = X$, $f_A(e_4) = \{h_1, h_3, h_5\}$.
Then the soft set F_A as consisting of the following collection of approximations, $F_A = \{(e_1, \{h_2, h_4\}), (e_2, X), (e_4, \{h_1, h_3, h_5\})\}$.

Definition 2.3: [4] Let $F_A \widetilde{\in}$ S(X). If $f_A(x) = \phi$ for all $x \in E$, then F_A is called an empty set, denoted by F_ϕ.$f_A(x) = \phi$ means that there is no element in X related to the parameter $x \in E$. Therefore, we do not display such elements in the soft sets, as it is meaningless to consider such parameters.

Definition 2.4: [4] Let $F_A \widetilde{\in}$ S(X). If $f_A(x) = X$ for all $x \in A$, then F_A is called an A- universal soft set, denoted by $F_{\tilde{A}}$. If A = E, then the A- universal soft set is called a universal soft set, denoted by $\widetilde{X}$.

Definition 2.5: [4] Let $F_A, F_B \widetilde{\in}$ S(X).Then F_A is a soft subset of F_B, denoted by $F_A \widetilde{\subseteq} F_B$ if $f_A(x) \subseteq f_B(x)$ for all $x \in E$. Let F_A and F_B are soft equal denoted by $F_A = F_B$ if $f_A(x) = f_B(x)$ for all $x \in E$.

Definition 2.6: [8] Let $F_A, F_B \widetilde{\in}$ S(X). Then soft union of F_A and F_B, denoted by $F_A \widetilde{\cup} F_B$, defined by $F_{A \widetilde{\cup} B} = F_C$, where $C = A \cup B$, and for all $e \in C$.

$$H(e) = \begin{cases} F(e) & \text{if } e \in A \setminus B \\ G(e) & \text{if } e \in B \setminus A \\ F(e) \cup G(e) & \text{if } e \in A \cap B \end{cases}$$

Definition 2.7: [5] Let $F_A \widetilde{\in}$ S(X). The soft power set of F_A is defined by $\widetilde{P}(F_A)$ is defined by $\widetilde{P}(F_A) = \{F_{A_i} \widetilde{\subseteq} F_A \; i \; \varepsilon \; I\}$ and its cardinality is defined by
$|\widetilde{P}(F_A)| = 2^{\sum_{x \in E} |f_A(x)|}$, where $|f_A(x)|$ is cardinality of $f_A(x)$.

Example 2.8: [5] Let $X = \{x_1, x_2\}$, $E = \{e_1, e_2\}$ and $\widetilde{X} = \{(e_1, \{x_1, x_2\}), (e_2, \{x_1, x_2\})\}$.Then the soft subsetsover $\widetilde{X}$ are

$F_{E_1} = \{(e_1, \{x_1\})\}$

$F_{E_2} = \{(e_1, \{x_2\})\}$.

$F_{E_3} = \{(e_1, \{x_1, x_2\})\}$.

$F_{E_4} = \{(e_2, \{x_1\})\}$.

$F_{E_5} = \{(e_2, \{x_2\})\}$.

$F_{E_6} = \{(e_2, \{x_1, x_2\})\}$

$F_{E_7} = \{(e_1, \{x_1\}), (e_2, \{x_1\})\}$

$F_{E_8} = \{(e_1, \{x_1\}), (e_2, \{x_2\})\}$.

$F_{E_9} = \{(e_1, \{x_1\}), (e_2, \{x_1, x_2\})\}$.

$F_{E_{10}} = \{(e_1, \{x_2\}), (e_2, \{x_1\})\}$.

$F_{E_{11}} = \{(e_1, \{x_2\}), (e_2, \{x_2\})\}$.

$F_{E_{12}} = \{(e_1, \{x_2\}), (e_2, \{x_1, x_2\})\}$.

$F_{E_{13}} = \{(e_1, \{x_1, x_2\}), (e_2, \{x_1\})\}$.

$F_{E_{14}} = \{(e_1, \{x_1, x_2\}), (e_2, \{x_2\})\}$.

$F_{E_{15}} = \widetilde{X}$

$F_{E_{16}} = F_\phi$

Are all subsets of $\widetilde{X}$ .So $|\widetilde{P}(F_E)| = 2^4 = 16$.

Definition 2.9: [12] Let $\widetilde{\tau}$ be the collection of soft sets over $\widetilde{X}$,then $\widetilde{\tau}$ is said to be a soft topology on X if statisfies the following axioms.

(i) $F_\phi, \widetilde{X}$ belong to $\widetilde{\tau}$.

(ii)the union of any member of soft sets in $\widetilde{\tau}$ belongs to $\widetilde{\tau}$.

(iii) the intersection of any two soft sets in $\widetilde{\tau}$ belongs to $\widetilde{\tau}$.The triplet ($\widetilde{X}$, $\widetilde{\tau}$,E) is called soft topological space over X. The members of $\widetilde{\tau}$ are said to be soft open set.

Example 2.10: Let us consider the soft subsets of $\widetilde{X}$ that are given in Example 2.8. Then $\widetilde{\tau}_1 = \{\widetilde{X}, F_\phi, F_{E_4}, F_{E_{10}}\}$, $\widetilde{\tau}_2 = \{\widetilde{X}, F_\phi, F_{E_1}, F_{E_7}, F_{E_{13}}\}$, $\widetilde{\tau}_3 = \{\widetilde{P}(F_E)\}$ are soft topologies on $\widetilde{X}$.

Definition 2.11: [6] Let $X \neq \phi$, τ_1 and τ_2 are two different topologies on X. Then $(X, \tau_1, \tau_2)$is called a Bitopological space.

Definition 2.12: [6] A subset S of X is called $\tau_{1,2}$-open if S =H∪K such that $H\in\tau_1$ and $K\in\tau_2$ and the complement of $\tau_{1,2}$-open set is $\tau_{1,2}$-closed set.

Example 2.13: [6] Let X = {a, b,c}, τ_1= {ϕ, X,{a}} and τ_2= {ϕ,X, {b}}.The sets in{ { ϕ, X, {a},{b},{a,b}}are called $\tau_{1,2}$-open set and sets in{ ϕ, X, {b,c},{a,c},{c}}are called $\tau_{1,2}$-closed set.

Definition 2.14: [6] Let S be subset of X. Then,(i) The $\tau_{1,2}$-closure of S, denoted by $\tau_{1,2}$-cl(S), isdefined by $\bigcap\{F : S \subseteq F, F$ is a $\tau_{1,2}$-closed set$\}$(ii) The $\tau_{1,2}$-interior of S, denoted by $\tau_{1,2}$-int(S), is defined by $\bigcup\{A : A \subseteq S, A$ is a $\tau_{1,2}$-open set$\}$

Definition 2.15: [13] Let $\tilde{X}$ be a nonempty soft set on the universe X, $\tilde{\tau}_1$ and are $\tilde{\tau}_2$ two different soft topologies on $\tilde{X}$. Then $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ is called a soft Bitopological space.

Definition 2.16: [13] Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ is be a soft bitopological space and $F_A \tilde{\subseteq} \tilde{X}$ .Then F_A is called $\tilde{\tau}_{1,2}$ - soft open if F_A = $F_B \tilde{\cup} F_C$,where $F_B \tilde{\in} \tilde{\tau}_1$ and $F_C \tilde{\in} \tilde{\tau}_2$. The complement of $\tilde{\tau}_{1,2}$ – soft open set is called $\tilde{\tau}_{1,2}$ - soft closed

Example 2.17: Let us considerthe soft subsets $\tilde{X}$ ofthat are given in Example 2.8 and $\tilde{\tau}_1$ ={ $\tilde{X}$, $F_\phi, F_{E_4}, F_{E_{10}}$ }, $\tilde{\tau}_2$ = { $\tilde{X}$, $F_\phi, F_{E_1}, F_{E_7}, F_{E_{13}}$ }. Then $\tilde{\tau}_{1,2}$ - soft open set are { $\tilde{X}$, $F_\phi, F_{E_1}, F_{E_4}, F_{E_7}, F_{E_{10}}, F_{E_{13}}$ } and $\tilde{\tau}_{1,2}$ - soft closed set are{ $\tilde{X}$, $F_\phi, F_{E_{12}}, F_{E_{14}}, F_{E_{11}}, F_{E_8}, F_{E_5}$ }

Definition 2.18: [12] Let F_A be a soft subset of $\tilde{X}$, Then

i) The $\tilde{\tau}_{1,2}$ - soft closure of F_A, denoted by $\tilde{\tau}_{1,2}$ -cl (F_A), is defined by $\bigcap\{ F_K : F_A \tilde{\subseteq} F_K, F_K$ isa $\tilde{\tau}_{1,2}$ - soft closed set$\}$

(ii) The $\tilde{\tau}_{1,2}$ - soft interior of F_A, denoted by $\tilde{\tau}_{1,2}$ -int(F_A), is defined by $\bigcup\{F_C : F_C \tilde{\subseteq} F_A, F_C$ is a $\tilde{\tau}_{1,2}$ - soft open set$\}$

Note that $\tilde{\tau}_{1,2}$ -int(F_A) is the biggest $\tilde{\tau}_{1,2}$ - soft open set that contained by F_A and $\tilde{\tau}_{1,2}$ -cl (F_A) is the smallest $\tilde{\tau}_{1,2}$ - soft closed set that containing F_A.

Definition 2.19: [1] A subset A of the topological space(X,τ) is calledb- open set if A⊆cl(int(A)) ∪int(cl(A)) andb- closed if cl (int(A)) ∩int (cl(A)) ⊆ A.
The following concepts are used in the sequel.

Definition 2.20: A softset F_A in a soft bitopological space $\tilde{X}$ is called

(i) (1, 2)*- soft regular open set if F_A = $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))and (1, 2)*- soft regular closed setif F_A = $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))

(ii)(1, 2)*-soft α-open set if $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))) and(1, 2)-*soft α-closed setif $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))) $\tilde{\subseteq} F_A$

(iii) (1,2)*- soft pre open if $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) and (1,2)*- soft pre closed if $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\subseteq} F_A$.

(iv) (1,2)*- soft semi open if $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) and(1,2)*- soft semi closed if $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq} F_A$.

(v)(1,2)*- soft β- open if $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))) and (1,2)*-soft β- closed if $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))) $\tilde{\subseteq} F_A$

The family of all (1, 2) *- soft regular open (resp. (1, 2)*-soft α open, (1, 2)*- soft preopen, (1, 2)*-soft semi open, (1, 2)*-soft β open) sets in may be denoted by (1, 2)*-sr open (resp. (1, 2)*- sα open, (1, 2)*-sp open, (1, 2)*-ss open, (1, 2)*-sβ open) sets.

Lemma 2.21: In $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space. we have the following results.
(i) Every (1, 2)*-soft regular open set is (1, 2)*-soft open
(ii)Every (1, 2)*-softopen set is (1, 2)*-soft α- open.
(iii) Every (1, 2)*-soft α open set is (1, 2)*-soft semi open.

(iv) Every (1, 2)*-soft preopen set is (1, 2)*-soft β- open.
(v) Every (1, 2)*-soft semi open set is (1, 2)*-soft β- open.
(vi) Every (1, 2)*-soft α open set is (1, 2)*-soft preopen
Proof: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space and $F_A \tilde{\in} \tilde{X}$. Suppose F_A be a (1,2)* -soft regular open set. Then F_A = $\tilde{\tau}_{1,2}$ -int ($\tilde{\tau}_{1,2}$ –cl(F_A)) since $\tilde{\tau}_{1,2}$ –cl(F_A) isa closed set in soft bitopological space and interior of any set is open. Therefore, (i) proved.
Let F_A be a (1, 2)* -soft open set. This implies F_A = $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))since $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ –cl(F_A) = $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))). Thus, (ii) proved.
Let F_A be a (1,2)* -soft α open set. This implies $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))) $\tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))Thus, (iii) proved.
Let F_A be a (1, 2)* -soft preopen set. This implies $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))). Thus, (iv) proved.
Let F_A be a (1, 2)* -soft semi open set. This implies $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))). Thus, (v) proved.
Let F_A be a (1, 2)* -soft α- open set. This implies $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))) $\tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -clt(F_A)). Thus, (vi) proved.

Remark 2.22: The converse of the above lemma is need not be true as seen in the following examples.
Example2.23: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space, where $\tilde{\tau}_1$ ={ $\tilde{X}$, $F_\phi, F_{E_4}, F_{E_{10}}$ }, $\tilde{\tau}_2$ = { $\tilde{X}$, $F_\phi, F_{E_1}, F_{E_7}, F_{E_{13}}$ }. Then $\tilde{\tau}_{1,2}$ - soft open set are { $\tilde{X}$, $F_\phi, F_{E_1}, F_{E_4}, F_{E_7}, F_{E_{10}}$, $F_{E_{13}}$ } and $\tilde{\tau}_{1,2}$ - soft closed set are{ $\tilde{X}$, $F_\phi, F_{E_{12}}, F_{E_{14}}, F_{E_{11}}, F_{E_8}, F_{E_5}$ }
(i) F_{E_7} is a (1, 2)*-soft open but not (1, 2)*-soft regular open.
(ii) F_{E_9} is a (1, 2)*-soft α open but not (1, 2)*-soft open.
(iii) F_{E_6} is a (1, 2)*-soft semi open but not (1, 2)*-soft α open.
(iv) F_{E_6} is a (1, 2)*-softβ open set but not (1, 2)*-soft preopen.

Example2.24: Let us consider the soft subsets of $\tilde{X}$ that are given in Example 2.8.Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space, where $\tilde{\tau}_1$ = { $\tilde{X}$, F_ϕ, F_{E_1} }, $\tilde{\tau}_2$={ $\tilde{X}$, F_ϕ F_{E_2} }. Then $\tilde{\tau}_{1,2}$ - soft open set are { $\tilde{X}$, F_ϕ, F_{E_1}, F_{E_2} F_{E_3} }, $\tilde{\tau}_{1,2}$ - soft closed set are{ $\tilde{X}$, $F_\phi, F_{E_{12}}, F_{E_9}, F_{E_6}$ }.
(v)The soft subset F_{E_4} is (1, 2)*-soft β -open set but not (1, 2)*-soft semi open.

Example 2.25: Let X= { x_1, x_2, x_3}, E = { e_1, e_2, e_3 }and $\tilde{X}$ = { (e_1, { x_1, x_2, x_3,x_4}), (e_2, { x_1, x_2, x_3,x_4}), (e_3, { x_1, x_2, x_3,x_4})}.Then $\tilde{\tau}_1$ = { $\tilde{X}$, F_ϕ, F_{E_1}, F_{E_2} F_{E_3} , F_{E_4}, F_{E_5} , F_{E_6} , $F_{E_7}, F_{E_8}, F_{E_9}, F_{E_{10}}, F_{E_{11}}, F_{E_{12}}, F_{E_{13}}, F_{E_{14}}, F_{E_{15}}$ }, $\tilde{\tau}_2$={ $\tilde{X}$, F_ϕ }. Where F_{E_1} = { (e_1, { x_1 }), (e_2, { x_2, x_3}), (e_3, { x_1,x_4})}. F_{E_2} ={ (e_1, {x_2,x_4}), (e_2, { x_1, x_3,x_4}), (e_3, { x_1, x_2,x_4})}. F_{E_3} ={(e_2, {x_3}), (e_3, {x_1})}. F_{E_4} = {(e_1, {x_1, x_2, x_4}), (e_2, X), (e_3, X}. F_{E_5} ={ (e_1, { x_1, x_3}), (e_2, { x_2,,x_4}), (e_3, X)}. F_{E_6} ={(e_1, {x_1}), (e_2, {x_2}}. F_{E_7} ={ (e_1, {x_1, x_3}), (e_2, {x_2, x_3,x_4}), (e_3, { x_1, x_2,x_4})}. F_{E_8} ={(e_2, {x_4}), (e_3, {x_2})}. F_{E_9} ={(e_1, X), (e_2, X), (e_3, {x_1, x_2, x_3})}. $F_{E_{10}}$ = { (e_1, { x_1, x_3}), (e_2, {x_2, x_3,x_4}), (e_3, { x_1, x_2})}. $F_{E_{11}}$ ={ (e_1, {x_2, x_3,x_4}), (e_2, X), (e_3, { x_1, x_2, x_3})}. $F_{E_{12}}$ ={ (e_1, { x_1}), (e_2, {x_2, x_3,x_4}), (e_3, {x_1, x_2,x_4})}. $F_{E_{13}}$ = {(e_1, {x_1}), (e_2, {x_2,x_4}), (e_3, {x_2})}. $F_{E_{14}}$ = {(e_1, {x_3,x_4}), (e_2, { x_1, x_2})}. $F_{E_{15}}$ ={(e_1, {x_1 }), (e_2, {x_2, x_3}), (e_3, { x_1})}. Then $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ is a soft bitopological space.(vi)Consider F_E , the soft subset of $\tilde{X}$ .Where F_E = { (e_1, { x_4}), (e_2, { x_1, x_2, x_3,}), (e_3, {x_2, x_4})}. $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl(F_E)) = $\tilde{X}$ and $F_E \tilde{\subseteq} \tilde{X}$. But $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))) = F_ϕ .Hence F_E is (1, 2)*-soft preopen set but not (1, 2)*-soft α open.

3. (1,2)*- soft b- open sets in this section we introduce (1, 2)*- soft b-open sets in soft bitopological spaces and study some of their properties.

Definition 3.1: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space and $F_A \tilde{\subseteq} \tilde{X}$ Then F_A is called(1, 2)*- soft b-open set(briefly (1, 2)* -sb-open)if $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl (F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A)).

Example 3.2: In Example 2.17, the(1, 2)*- soft b-open sets are { $\tilde{X}$, F_ϕ, F_{E_1}, F_{E_4}, F_{E_6} , F_{E_7}, F_{E_8}, $F_{E_9}, F_{E_{10}}, F_{E_{12}}, F_{E_{13}}$ }.

Theorem 3.3: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space. Then(i) Every (1, 2)* -soft preopen set is (1 2)* -soft b-open set.(ii) Every (1, 2)* -soft b- open set is (1, 2)* -soft β-open set.(iii) Every (1, 2)* -soft semi open set is (1, 2)* -soft b-open set.

Proof: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space and $F_A \in \tilde{X}$ Let F_A is a (1, 2)* -soft preopen set. Then $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -int(F_A) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)). Thus (i) proved

Let F_A be a (1,2)* -soft b-open set. Then $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -int ($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl (F_A)) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))). Thus

(ii) proved.

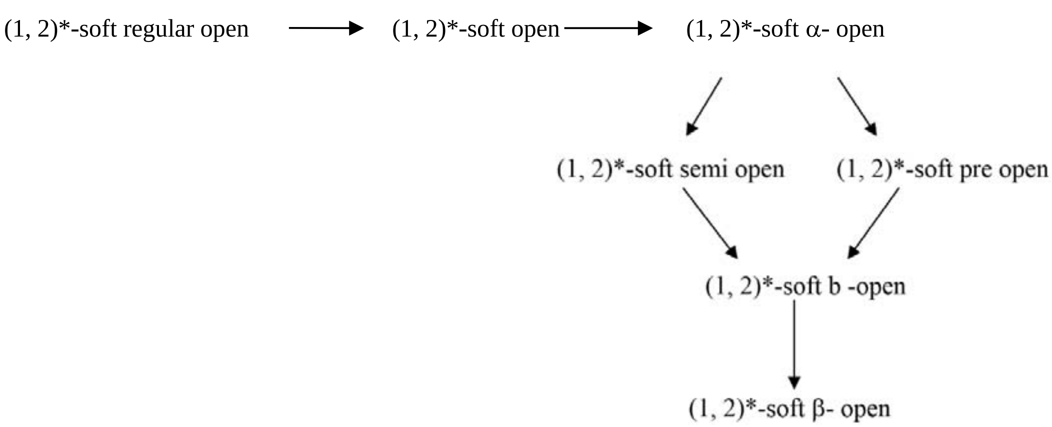
Let F_A is a (1,2)* -soft semi open set.This implies $F_A \tilde{\subseteq} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -int(F_A) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)). Thus

(iii) proved.

Remark 3.4: The converse of the above lemma is need not be true as seen in the following example.

Example3.5: Let us consider the soft subsets of $\tilde{X}$ that are given in Example 2.8.Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space, where $\tilde{\tau}_1$ = { $\tilde{X}$, F_ϕ, F_{E_1} }, $\tilde{\tau}_2$={ $\tilde{X}$, F_ϕ F_{E_2} }. Then $\tilde{\tau}_{1,2}$ - soft open set are{ $\tilde{X}$, F_ϕ, F_{E_1}, F_{E_2} F_{E_3} }, $\tilde{\tau}_{1,2}$ - soft closed set are{ $\tilde{X}$, $F_\phi, F_{E_{12}}, F_{E_9}, F_{E_6}$ }.(i) The soft set F_{E_7} in $\tilde{X}$ is (1, 2)* -soft b-open set but not (1, 2)* -soft preopen set.(ii)The soft set F_{E_5} in $\tilde{X}$ is (1, 2)* -soft β-open set but not (1, 2)* -soft b- open set.(iii) The soft set F_{E_4} in $\tilde{X}$ is (1, 2)* -soft b-open set but not (1, 2)* -soft semi open set.

Remark 3.6: The above discussions are summarized in the following diagrams:



Theorem 3.7: An arbitrary union of (1, 2)*-soft b-open sets are (1, 2)*- soft b-open set.

Proof: Let {(F_A)α} be a collection of (1, 2)* soft b-open sets. Then for eachα,(F_A)α $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl (F_A)α) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A)α). $\bigcup_\alpha$ ((F_A)α) $\tilde{\subseteq}$ $\bigcup_\alpha$ { $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl (F_A)α) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A)α)} $\tilde{\subseteq}$ [$\bigcup_\alpha$ { $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl (F_A

)α)}] $\tilde{\cup}$ [$\bigcup_{\alpha}$ {$\tilde{\tau}_{1,2}$-cl ($\tilde{\tau}_{1,2}$-int(F_A)α)}] $\tilde{\subseteq}$[{$\tilde{\tau}_{1,2}$-int { $\bigcup_{\alpha}$ ($\tilde{\tau}_{1,2}$-cl (F_A)α)}] $\tilde{\cup}$ [$\tilde{\tau}_{1,2}$-cl{ $\bigcup_{\alpha}$ ($\tilde{\tau}_{1,2}$-int(F_A)α)}] $\tilde{\subseteq}$[$\tilde{\tau}_{1,2}$-int {($\tilde{\tau}_{1,2}$-cl{$\bigcup_{\alpha}$ (F_A)α})}] $\tilde{\cup}$ [$\tilde{\tau}_{1,2}$-cl{($\tilde{\tau}_{1,2}$-int {$\bigcup_{\alpha}$ (F_A)α})}]. Hencethe theorem.

Result 3.8: The intersection of two (1,2)* -soft b-open sets need not be(1,2)* -soft b-open set. In example 3.2, F_{E_6} $\tilde{\cap}$ F_{E_8} = F_{E_5} , which is not (1,2)* -soft b-open set.

Theorem 3.9: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space.(i) The intersection of (1,2)*-soft open set and (1,2)*-sb-open set is (1,2)*-sb-open set.(ii) The intersection of (1,2)*-sα- open set and (1,2)*-sb-open set is (1,2)*-sb-open set.

Proof: Let F_A , $F_B \in (\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ bea(1, 2)*-soft open set and (1,2)*-sb-open set respectively then F_A $\tilde{\cap}$ F_B $\tilde{\subseteq}$ F_A $\tilde{\cap}$[$\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_B)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_B))]=**[** F_A $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_B)] $\tilde{\cup}$ **[** F_A $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_B)]=**[** F_A $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_B)] $\tilde{\cup}$ **[** F_A $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_B)] $\tilde{\subseteq}$ **[** $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A) $\tilde{\cap}$ cl($\tilde{\tau}_{1,2}$ –int(F_B)] $\tilde{\cup}$ **[** $\tilde{\tau}_{1,2}$-int- ($\tilde{\tau}_{1,2}$ –cl(F_A) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_B)] $\tilde{\subseteq}$ **[** $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A $\tilde{\cap}$ F_B)] $\tilde{\cup}$ **[** $\tilde{\tau}_{1,2}$-int -($\tilde{\tau}_{1,2}$ –cl(F_A $\tilde{\cap}$ F_B)].Thus (i)proved.

Let F_A , $F_B \in (\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ bea(1, 2)*-soft α- open setand (1, 2)*-sb-open set respectively, then F_A $\tilde{\cap}$ F_B $\tilde{\subseteq}$ **[** $\tilde{\tau}_{1,2}$-int -($\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$ –int(F_A)] $\tilde{\cap}$ [$\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_B)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_B))]=[$\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$ –int(F_A) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_B))] $\tilde{\cup}$ **[** $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$ –int(F_A) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_B))] $\tilde{\subseteq}$ **[** $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_B))] $\tilde{\cup}$ **[** $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_B))] $\tilde{\subseteq}$ **[** $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$ –int(F_A $\tilde{\cap}$ F_B))] $\tilde{\cup}$ **[** $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A $\tilde{\cap}$ F_B))]. Thus
(ii)proved.

Theorem 3.10: Any (1, 2)*-sb-open set in soft topological space $\tilde{X}$, $\tilde{\tau}_{1,2}$-cl(F_A)is a(1, 2)*-sr-closed set.

Proof: Let F_A be a (1,2)* -soft b-open set. This implies F_A $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)). Also, $\tilde{\tau}_{1,2}$ –cl(F_A) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A))) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A))) and $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A))) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ –cl(F_A). Therefore, $\tilde{\tau}_{1,2}$ –cl(F_A)= $\tilde{\tau}_{1,2}$ –cl($\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A))). So, $\tilde{\tau}_{1,2}$-cl(F_A)is a(1,2)*-sr-closed set.

Theorem 3.11: Let F_A be a (1, 2)*-sb-open set in soft topological space $\tilde{X}$,(i) If $\tilde{\tau}_{1,2}$-cl(F_A)=ϕthen F_A is a(1, 2)*-ss-open set.(ii)If $\tilde{\tau}_{1,2}$-int(F_A)=ϕthen F_A is a(1, 2)*-sp-open set.

Proof: Let F_A be a (1, 2)* -soft b-open set. This implies F_A $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)).Since $\tilde{\tau}_{1,2}$-cl(F_A)=ϕ, F_A $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A)). Thus (i) proved. Since $\tilde{\tau}_{1,2}$-int(F_A)=ϕ, F_A $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)). Thus (ii) proved.

Theorem 3.12: Let F_A be a (1, 2)*-sb-open set in soft bitopologicalspace $\tilde{X}$,(i) If F_A is a(1, 2)*-sr-closed set then F_A is a(1,2)*-sp-open set.(ii)If F_A is a(1, 2)*-sp-open set then F_A is a(1,2)*-ss-open set.

Proof: Since F_A be a (1, 2)* -soft b-open set, F_A $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)).Let F_A be a (1, 2)* -sr-closed set, F_A = $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A)).Then F_A $\tilde{\subseteq}$ F_A $\tilde{\cup}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)).which implies, F_A $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)).Thus (i) proved. Let F_A be a (1,2)* -soft sr-open set, F_A = $\tilde{\tau}_{1,2}$-int($\tilde{\tau}_{1,2}$ –cl(F_A)). F_A $\tilde{\subseteq}$ F_A $\tilde{\cup}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A))which implies, F_A $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$-cl($\tilde{\tau}_{1,2}$ –int(F_A)).Thus (ii) proved.

Theorem 3.13: F_A be a (1, 2)*-sb-open set in $\tilde{X}$ if and only if F_A is the union of(1, 2)*-ss-open set and (1, 2)*-sp-open set.

Proof: Follows from the definition of (1, 2)*-sb-open set in $\tilde{X}$.

4. (1,2)*-soft b- closed sets

In this section we introduce (1, 2)*- soft b-closed sets in soft bitopological spaces and study some of their properties.

Definition 4.1: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space and $F_A \tilde{\subseteq} \tilde{X}$. Then F_A is called(1,2)*- soft b-closed set (briefly (1, 2)* -sb-closed) if $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl (F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A)) $\tilde{\subseteq} F_A$. The complement of (1, 2)*- soft b-closed set is (1,2)*- soft b-open set.

Example 4.2: In Example 2.17, the(1, 2)*- soft b-closed sets are{ $\tilde{X}$, $F_\phi, F_{E_{12}}, F_{E_{14}}, F_{E_8}, F_{E_{11}}, F_{E_{10}}, F_{E_2}, F_{E_8}, F_{E_1}, F_{E_5}$ }

Theorem 4.3: An arbitrary intersection of (1,2)*-soft b-closed sets is(1,2)*-soft b-closed set.

Proof: Let {(F_B)α} be a collection of(1,2)* soft b-closed sets in $\tilde{X}$. Then for each α, $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ -cl (F_B)α) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_B)α) $\tilde{\subseteq}$(F_B)α. Since{(F_B)α^C} is an arbitrary family of(1, 2)*-sb-open set in $\tilde{X}$. Hence, by theorem3.7, $\bigcup_\alpha (F_B)_\alpha^C$ is a(1,2)*-sb-open set. But $\bigcup_\alpha (F_B)_\alpha^C = \left[\bigcap_\alpha (F_{\mathbf{B}})_\alpha\right]^C$. Therefore $\bigcap_\alpha (F_B)_\alpha$ is a (1,2)*-sb-closed set.

Result 4.4: The union of two (1, 2)*-soft b-closed sets need not be (1, 2)*-soft b-closed set. In example 3.5, F_{E_1} and F_{E_2} are (1, 2)*-soft b-closed sets. But the union $F_{E_1} \tilde{\cup} F_{E_2} = F_{E_3}$,which is not (1, 2)*-soft b-closed set.

Theorem 4.5: Let F_A be a (1, 2)*-sb-closed set in soft bitopologicalspace $\tilde{X}$,(i) If F_A is a(1, 2)*-sr-closed set then F_A is a(1, 2)*-ss-closed set.(ii) If F_A is a(1, 2)*-sr-open set then F_A is a(1, 2)*-sp-closed set.

Proof: Since F_A be a(1, 2)*-sb-closed set, $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq} F_A$. Since F_A is a(1, 2)*-sr-closed set, $F_A = \tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A)). Therefore, $F_A \tilde{\cap} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq} F_A$. Thus, $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq} F_A$. Thus (i) proved.

Since F_A is a(1,2)*-sr-open set, $F_A = \tilde{\tau}_{1,2}$ -int ($\tilde{\tau}_{1,2}$ -cl(F_A)). Therefore, $F_A \tilde{\cap} \tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\subseteq} F_A$. This implies, $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\subseteq} F_A$ .Thus (ii) proved.

Theorem 4.6: Any (1,2)*-sb-closed set in soft bitopological space $\tilde{X}$, $\tilde{\tau}_{1,2}$ -int(F_A)is a(1,2)*-sr-open set.

Proof: Let F_A be a (1, 2)* -sb-closed set. This implies $\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\subseteq} F_A$. Also, $\tilde{\tau}_{1,2}$ –int(F_A) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ –int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$ –int($\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ –int(F_A).Thus $\tilde{\tau}_{1,2}$ –int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A))) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ –int(F_A).Also $\tilde{\tau}_{1,2}$ –int(F_A) $\tilde{\subseteq}$ $\tilde{\tau}_{1,2}$ –int($\tilde{\tau}_{1,2}$ -cl($\tilde{\tau}_{1,2}$ –int(F_A)))). Therefore, $\tilde{\tau}_{1,2}$ –int(F_A)= $\tilde{\tau}_{1,2}$ –int($\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ –int(F_A))).So, $\tilde{\tau}_{1,2}$ -int(F_A)is a(1, 2)*-sr-open set.

Theorem 4.7: F_A be a (1, 2)*-sb-closed set in $\tilde{X}$ if and only if F_A is the intersection of(1, 2)*-ss-closed setand (1, 2)*-sp-closed set.

Proof: Follows from the definition 4.1.

5. (1,2)* - soft b- interior and(1,2)* - soft b- closure

Definition 5.1: Let $(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2)$ be a soft bitopological space and F_A be a soft set over $\tilde{X}$ (i) (1, 2)*-soft b-closure (briefly (1, 2)* -sbcl(F_A)) of a set F_A in $\tilde{X}$ defined by(1, 2)*- sbcl(F_A) = $\tilde{\cap}$ { $F_E \tilde{\supseteq} F_A$: F_E is a (1, 2)*- soft b-closed set in $\tilde{X}$ }(ii) (1, 2)*-soft b-interior (briefly (1, 2)* -sbint(F_A)) of a set F_A in $\tilde{X}$ defined by(1, 2)*- sbint(F_A) = $\tilde{\cup}${ $F_B \tilde{\subseteq} F_A$: F_B is a (1, 2)*- soft b-open set in $\tilde{X}$ }

(1, 2)*- sbcl(F_A) is the smallest(1, 2)*- soft b-closed set in $\tilde{X}$ which contains F_A and(1, 2)*- sbint(F_A)is the largest(1, 2)*- soft b-open set in $\tilde{X}$ which is contained in F_A.
The following lemma is used in the sequal.

Lemma 5.2: Let F_A be a soft set in a soft bitopologicalspace $\tilde{X}$. Then(i) (1, 2)*-sscl(F_A)= $F_A \tilde{\cup} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))(ii) (1, 2)*-ssint(F_A)= $F_A \tilde{\cap} \tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))(iii) (1, 2)*-spcl(F_A)= $F_A \tilde{\cup} \tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))(iv) (1, 2)*-spint(F_A)= $F_A \tilde{\cap} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A))

Therem5.3: Let F_A be a soft set in a soft bitopologicalspace $\tilde{X}$. Then(i) (1,2)*- sbcl(F_A)= $F_A \tilde{\cup}$ [$\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))].(ii) (1, 2)*- sbint(F_A)= $F_A \tilde{\cap}$ [$\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))].

Proof: Proof is obvious.

Therem5.4: In $\left(\tilde{X}, \tilde{\tau}_1, \tilde{\tau}_2\right)$ be a soft bitopological space have the following results:(i)(1,2)*- sbcl($F_A \tilde{\cup} F_B$) $\tilde{\supseteq}$ (1,2)*- sbcl(F_A) $\tilde{\cup}$ (1,2)*- sbcl(F_B).(ii)(1,2)*- sbcl($F_A \tilde{\cap} F_B$) $\tilde{\subseteq}$ (1,2)*- sbcl(F_A) $\tilde{\cap}$ (1,2)*- sbcl(F_B).(iii)(1,2)*- sbint($F_A \tilde{\cup} F_B$) $\tilde{\supseteq}$ (1,2)*- sbint(F_A) $\tilde{\cup}$ (1,2)*- sbint(F_B).(iv)(1,2)*- sbint($F_A \tilde{\cap} F_B$) $\tilde{\subseteq}$ (1,2)*- sbintl(F_A) $\tilde{\cap}$ (1,2)*- sbint(F_B).

Proof: Since $F_A \tilde{\subseteq} F_A \tilde{\cup} F_B$ or $F_B \tilde{\subseteq} F_A \tilde{\cup} F_B$ This implies,(1,2)*- sbcl(F_A) $\tilde{\subseteq}$ (1,2)*- sbcl($F_A \tilde{\cup} F_B$) or(1,2)*- sbcl(F_B) $\tilde{\subseteq}$ (1,2)*- sbcl($F_A \tilde{\cup} F_B$).Thus, (1,2)*- sbcl($F_A \tilde{\cup} F_B$) $\tilde{\supseteq}$ (1,2)*- sbcl(F_A) $\tilde{\cup}$ (1,2)*- sbcl(F_B).
(ii) Similar to that of (i).Since $F_A \tilde{\subseteq} F_A \tilde{\cup} F_B$ or $F_B \tilde{\subseteq} F_A \tilde{\cup} F_B$ This implies,(1,2)*- sbint(F_A) $\tilde{\subseteq}$ (1,2)*- sbint($F_A \tilde{\cup} F_B$) or(1,2)*- sbint(F_B) $\tilde{\subseteq}$ (1,2)*- sbint($F_A \tilde{\cup} F_B$).Thus,(1,2)*- sbint($F_A \tilde{\cup} F_B$) $\tilde{\supseteq}$ (1,2)*- sbint(F_A) $\tilde{\cup}$ (1,2)*- sbint(F_B).(iv) Similar to that of (iii).
Therem5.5: Let F_A be a soft set in a soft bitopologicalspace $\tilde{X}$. $F_A \tilde{\subseteq} \tilde{X}$ (i) [(1,2)*- sbcl(F_A)]^C = $\tilde{X}$ \(1, 2)*-sbint(F_A)(ii) [(1,2)*- sbint(F_A)]^C = $\tilde{X}$ \(1, 2)*-sbcl(F_A)^C

Proof:(i) Let $F_A \tilde{\subseteq} \tilde{X}$ (1,2)*- sbcl(F_A)= $\tilde{\cap}$ { $F_E \tilde{\supseteq} F_A$: F_E is a (1, 2)*- soft b-closed set in $\tilde{X}$ }[(1,2)*- sbcl(F_A)]^C = [$\tilde{\cap}$ { $F_E \tilde{\supseteq} F_A$: F_E is a (1, 2)*- soft b-closed set in $\tilde{X}$ }]^C
= $\tilde{\cup}$ { $F_E{}^C \tilde{\subseteq} F_A{}^C$: $F_E{}^C$ is a (1, 2)*- soft b-open set in $\tilde{X}$ }
= (1, 2)*-sbint(F_A)^C= $\tilde{X}$ \(1, 2)*-sbint(F_A)(ii)Apply soft interior, we get the result.

Therem5.6: Let F_A be a soft set in a soft bitopologicalspace $\tilde{X}$.(i) (1, 2)*- sbcl(F_A) $\tilde{\subseteq}$ (1, 2)*-sscl(F_A) $\tilde{\cap}$ (1, 2)*-spcl(F_A)(ii) (1, 2)*- sbint(F_A) $\tilde{\supseteq}$ (1,2)*-ssint(F_A) $\tilde{\cup}$ (1, 2)*-spint(F_A)

Proof: (i)(1, 2)*-sscl(F_A) $\tilde{\cap}$ (1,2)*-spcl(F_A) $\tilde{\supseteq}$ [$F_A \tilde{\cup} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cap}$ $F_A \tilde{\cup} \tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))] = $F_A \tilde{\cup}$ [$\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cap}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))] =(1,2)*- sbcl(F_A). (ii) (1,2)*-ssint(F_A) $\tilde{\cup}$ (1,2)*-spint(F_A) $\tilde{\subseteq}$ [($F_A \tilde{\cap}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))) $\tilde{\cap}$ ($F_A \tilde{\cap} \tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)))]= $F_A \tilde{\cap}$ [$\tilde{\tau}_{1,2}$ -int($\tilde{\tau}_{1,2}$ –cl(F_A)) $\tilde{\cup}$ $\tilde{\tau}_{1,2}$ -cl ($\tilde{\tau}_{1,2}$ -int(F_A))] = (1,2)*- sbint(F_A).

Therem5.7: In asoft set in a soft bitopologicalspace $\tilde{X}$. (i) F_A is (1, 2)*-sb-closed if and only if F_A =(1, 2)*- sbcl(F_A)(ii) F_A is (1, 2)*-sb-open if and only if F_A =(1, 2)*- sbint(F_A)
Proof: (i) Suppose F_A = (1, 2)*-sbcl(F_A) = $\tilde{\cap}$ $F_E \tilde{\supseteq} F_A$: F_E is a (1, 2)*- sb-closed set in $\tilde{X}$ }. Therefore, F_A is (1, 2)*-sb-closed. Conversely, suppose F_A is (1, 2)*-sb-closed in $\tilde{X}$. If we take $F_A \tilde{\subseteq} F_A$ and F_A is (1, 2)*-sb-closed. Therefore, $F_A \in$ $\tilde{\cap}$ { $F_E \tilde{\supseteq} F_A$: F_E is a (1, 2)*- soft b-closed set in $\tilde{X}$ }. $F_A \tilde{\subseteq} F_E$ implies, F_A = $\tilde{\cap}$ { $F_E \tilde{\supseteq} F_A$: F_E is a (1, 2)*- soft b-closed set in $\tilde{X}$ } =(1, 2)*- sbcl(F_A).

Conclusion

In this paper, we introduce the concept of (1, 2)*- soft b-open sets and (1, 2)*-soft b-closed sets insoft bitopological spaces. Also westudy the properties of (1,2)*-soft b-interior and (1,2)*-soft b-closure. In future, using this concept various type of open sets on soft bitopological spaces shall be studied and developed.

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