Soft ρ-sets where ρ∈{p, q, Q}

M. Kiruthika

Department of Mathematics, Suguna College of Engineering, Coimbatore-641014, India.

kiruthi.karpagam@gmail.com

Abstract -In this paper soft p-set, soft q-set and soft Q-set are defined and their properties are characterized.

Keywords:Parametrized family, Soft sets, Soft Topology, Soft open sets.

I.Introduction

Molodtsov [4] initiated the concept of soft set theory,which is a set associated with parameters and completely new approach for modelingvagueness and uncertainty. He successfully applied thesoft set theory into several directions such as smoothnessof functions, game theory, Riemann Integration, theoryof measurement, and so on. Soft set theory and itsapplications have shown great development because of the general nature of parametrizationexpressed by a soft set. Shabir and Naz [5]introduced the notion of soft topological spaces whichare defined over an initial universe with a fixed set ofparameters. Later, Zorlutuna et al.[8], Aygunoglu andAygun [1] and Hussain[3] et al are continued to study theproperties of soft topological space. Thangavelu and Rao[6,7] introduced the notion of p-set , q-set in topological spaces.In this paper soft p-set, soft q-set and soft Q-set are defined and their properties are characterized.

II.Preliminaries

Let (X, τ) be a topological space and (X, $\tilde{\tau}$,E) be a soft topological space. Let A be a subset of X, and $\tilde{F}$ be a soft set over X with parameter space E.

*Int*A and*Cl*A denote the interior and closure of A in (X, τ) respectively. $\tilde{S}cl\tilde{F}$ and $\tilde{S}\,\text{int}\,\tilde{F}$ denotes the soft closure of $\tilde{F}$ and soft interior of $\tilde{F}$ in the soft topological space.

Definition 2.1

A subset A of a space (X, τ) is called

(i) a p-set if $ClIntA \subseteq IntClA$

(ii) a q-set if $IntClA \subseteq ClIntA$

(iii) a Q-set if $IntCl$A=$ClInt$A.

Definition 2.2

The pair (F, E) is called a soft set over X, where $F:E\rightarrow 2^X$ is a mapping. Conveniently (F, E) is represented by F_E which is known as a soft set over (X, E). If the parameter space E is fixed, we use F instead of $F_{E.}$ S(X, E) denotes the collection of all soft subsets ofX with parameter set E. S(X, E)={$F:E\rightarrow 2^X$}. If F∈S(X, E) then we write F={(e, F(e)):e∈E}. The next definition is due to Maji, Biswas [31].

Definition 2.3

Let F and G be any two soft sets over a common universe X with a parameter space E. Then

(i) F is a soft subset of Gdenoted by $F \,{}^{s}\!\subseteq G$ if F(e)⊆G(e) for all e∈E.

(ii) F=G if F(e)=G(e) for all e∈E.

(iii)The soft complement of F, denoted by F^c, is defined as

F^c={(e, F^c(e)):e∈E}={(e, X\F(e)):e∈E}. That is F^c(e)=X\F(e).

Definition 2.4

Let F be a soft set over X and x∈X. Then x∈F whenever x∈F(e) for every e∈E.

The notions of a soft point and a quasi soft set are respectively studied by Zorlutuna[8] and Evanzalin [2]. These two notions are useful to study a link between topology and soft topology.

Definition 2.5

Let x∈X, A⊆X and e∈E.

(i) The soft set $x_e$is called a soft point if $x_e(e)=\{x\}$ and $x_e(\alpha)=\varnothing$ for every $\alpha\in E\setminus\{e\}$.

(ii) The soft set $A_e$is called a quasi soft set if $A_e(e)=A$ and $A_e(\alpha)=\varnothing$ for every $\alpha\in E\setminus\{e\}$.

Remark 2.6

Every soft point is a quasi soft set. But the quasi soft set need not be a soft point.

Definition 2.7

A sub collection ${}^s\tau$of S(X, E) is said to be a soft topology over(X, E) if

(i) $\varnothing_E$ and X_E belong to${}^s\tau$,

(ii) ${}^s\tau$ is closed under finite intersection, (iii)$^{s}\tau$ is closed under arbitrary union.

If $^{s}\tau$is a soft topology on X then the triplet (X, $^{s}\tau$, E) is called a softtopological space over (X, E) and $^{s}\tau$ is a soft topology over (X, E). The members of $^{s}\tau$ are called the soft open sets in (X, $^{s}\tau$, E). The soft complement of a soft open set is soft closed. The soft interior and soft closure of soft set can be defined in the usual way. ^{s}IntF and ^{s}ClF denote respectively the soft interior and soft closure of F.

Lemma 2.8

Let(X, $^{s}\tau$, E) be a soft topological space. Then for each e$\in$E, the collection of subsets F(e) of X, F$\in^{s}\tau$ is a topology on X, denoted by $(^{s}\tau)_e$.

The family $\{(^{s}\tau)_e : e\in E\}$ is called theparametrized family of topologies induced by the soft topology $^{s}\tau$.

Lemma2.9

Let(X, $^{s}\tau$, E) be a soft topological space and F$\in$S(X, E). Then for e$\in$E, $(^{s}Int F)(e)\subseteq Int(F(e))\subseteq Cl(F(e))\subseteq(^{s}Cl F)(e)$,

Evanzalin [2] has proved some interesting properties of the soft interior and soft closure operators as given in the next two lemmas.

Lemma2.10

Let(X, $^{s}\tau$, E) be a soft topological space with $QS((^{s}\tau)_e)$ is contained in $^{s}\tau$ for every e$\in$E and F$\in$S(X, E). Then for every e$\in$E

(i) $(^{s}Int F)(e)=Int(F(e))$ and $(^{s}Cl F)(e)=Cl(F(e))$

(ii) $(^{s}Cl\,^{s}Int F)(e)=Cl Int(F(e))$ and $(^{s}Int\,^{s}Cl F)(e)=Int Cl(F(e))$

(iii) $(^{s}Int\,^{s}Cl\,^{s}Int F)(e)=Int Cl Int(F(e))$ and $(^{s}Cl\,^{s}Int\,^{s}Cl F)(e)=Cl Int Cl(F(e))$

III. Main Results

Definition 3.1

A soft subset F in a soft topological space (X, $^{s}\tau$, E) is called

(i) a soft p-set if $^{s}Cl\,^{s}Int F \;^{s}\!\subseteq\, ^{s}Int\,^{s}Cl F$.

(ii) a soft q-set if $^{s}Int\,^{s}Cl F \;^{s}\!\subseteq\, ^{s}Cl\,^{s}Int F$.

(iii) a soft Q-set if $^{s}Cl\,^{s}Int F = ^{s}Int\,^{s}Cl F$

Let X ={a,b,c,d} and E={α,β} in the following two illustrations.

Illustration 3.2

Let ${}^s\tau=\{\varnothing_E, X_E, F_1, F_2, F_3\}$ where $F_1=\{(\alpha,\{a\}), (\beta, \varnothing)\}$, $F_2=\{(\alpha,\{c\}), (\beta, \varnothing)\}$ and $F_3=\{(\alpha,\{a,c\}), (\beta,\varnothing)\}$. Then $(X, {}^s\tau, E)$ is a soft topological space.

The corresponding soft closed sets$=\{\varnothing_E, X_E, H_1, H_2, H_3\}$ where, $H_1=\{(\alpha, \{b,c, d\}), (\beta, X)\}$, $H_2=\{(\alpha, \{a,b,d\}), (\beta, X)\}$ and $H_3=\{(\alpha, \{b,d\}), (\beta,X)\}$.

Let $F=\{(\alpha, \{c\}),(\beta, \varnothing)\}$. Then ${}^sCl{}^sInt F= {}^sCl(\{(\alpha, \{a\}), (\beta, \varnothing)\})= \{(\alpha,\{a, b, d\}), (\beta, X)\}$ and ${}^sInt{}^sCl F= {}^sInt(\{(\alpha, \{a, b, d\}), (\beta, X)\})=\{(\alpha, \{a\}), (\beta, \varnothing)\}$.

Also ${}^sInt{}^sCl F=\{(\alpha, \{a\}), (\beta,\varnothing)\} {}^s\subseteq \{(\alpha, \{a, b, d\}), (\beta, X)\}= {}^sCl{}^sInt F$ that implies F is a soft q-set but neither a soft Q-set nor a soft p-set.

Suppose $H=\{(\alpha, \{a, c\}), (\beta, \varnothing)\}$. ${}^sCl{}^sInt H= {}^sCl(\{(\alpha, X), (\beta, X)\})=X_E$ and ${}^sInt{}^sCl H= {}^sInt(\{(\alpha, X), (\beta, X)\})=X_E$. Since ${}^sCl{}^sInt H= {}^sInt{}^sCl H$, it follows that H is a soft Q-set.

Illustration 3.3

Let ${}^s\tau=\{\varnothing_E, X_E, G_1, G_2, G_3\}$ where $G_1=\{(\alpha, \{b, c, d\}), (\beta, X)\}$, $G_2=\{(\alpha, \{a,b,d\}), (\beta, X)\}$ and $G_3=\{(\alpha, \{b, d\}), (\beta, X)\}$. Then $(X, {}^s\tau, E)$ is a soft topological space.The corresponding soft closed sets $=\{\varnothing_E, X_E, H_1, H_2, H_3\}$ where $H_1=\{(\alpha, \{a\}),(\beta,\varnothing)\}$, $H_2=\{(\alpha, \{c\}), (\beta,\varnothing)\}$ and $H_3=\{(\alpha, \{a,c\}), (\beta,\varnothing)\}$.

Let $F=\{(\alpha,\{a,b,c\}), (\beta, \{d\})\}$. Then ${}^sCl{}^sInt F={}^sCl(\{(\alpha,\varnothing), (\beta, \varnothing)\})=\varnothing_E$ and ${}^sInt{}^sCl F={}^sInt(\{(\alpha, X), (\beta, X)\})=X_E$. Since ${}^sCl{}^sInt F {}^s\subseteq {}^sInt{}^sCl F$, F is a soft p-set but it is neither a soft q-set nor a soft Q-set.

The soft complement of a ρ-set is again a ρ-set as established in the next proposition.

Proposition 3.4

Let F be a soft subset of a soft topological space $(X, {}^s\tau , E)$. Then

(i) F is a soft p-set⇔F^c is a soft p-set.

(ii) F is a soft q-set⇔F^c is a soft q-set.

(iii) F is a soft Q-set⇔F^c is a soft Q-set.

(iv) F is a soft Q-set⇔F is a soft p-set and a soft q-set.

Proof:

F is a soft p-set⇔${}^sCl{}^sInt F {}^s\subseteq {}^sInt{}^sCl F$

$\Leftrightarrow({}^{s}Cl\,{}^{s}Int\mathrm{F})^{cs} \supseteq ({}^{s}Int\,{}^{s}Cl\mathrm{F})^{c}$

$\Leftrightarrow {}^{s}Cl\,{}^{s}Int[(\mathrm{F})^{c}] \;{}^{s}\!\subseteq {}^{s}Int\,{}^{s}Cl[(\mathrm{F})^{c}]$

$\Leftrightarrow(\mathrm{F})^{c}$ is a soft p-set.

The other assertions can be analogously proved and the proof is completed.

The following proposition shows that a soft set is soft ρ-set iffit is a ρ-set in a topology induced by the soft topology.

Proposition 3.5

Let(X, ${}^{s}\tau$, E) be a soft topological space with the condition that QS(($^{s}\tau)_{e}$) is contained in ${}^{s}\tau$ for every e∈E. Let F∈S(X, E). Then F is a soft ρ-set if and only if F(e) is a ρ-set in (X, $({}^{s}\tau)_{e}$) for every e∈E.

Proof:

By using Lemma 1.5.5, for every e∈E, $({}^{s}Cl\,{}^{s}Int\mathrm{F})(e)=ClInt(\mathrm{F}(e))$ and $({}^{s}Int\,{}^{s}Cl\mathrm{F})(e)=IntCl(\mathrm{F}(e))$.

F is a soft p-set$\Leftrightarrow {}^{s}Cl\,{}^{s}Int\mathrm{F} \;{}^{s}\!\subseteq {}^{s}Int\,{}^{s}Cl\mathrm{F}$

$\Leftrightarrow({}^{s}Cl\,{}^{s}Int\mathrm{F})(e)\subseteq({}^{s}Int\,{}^{s}Cl\mathrm{F})(e)$ for every e∈E

$\Leftrightarrow ClInt(\mathrm{F}(e))\subseteq IntCl(\mathrm{F}(e))$

$\Leftrightarrow$F(e) is a p-set in $(X,({}^{s}\tau)_{e})$

F is a soft q-set$\Leftrightarrow {}^{s}Int\,{}^{s}Cl\mathrm{F} \;{}^{s}\!\subseteq {}^{s}Cl\,{}^{s}Int\mathrm{F}$

$\Leftrightarrow({}^{s}Int\,{}^{s}Cl\mathrm{F})(e)\subseteq({}^{s}Cl\,{}^{s}Int\mathrm{F})(e)$ for every e∈E

$\Leftrightarrow IntCl(\mathrm{F}(e))\subseteq ClInt(\mathrm{F}(e))$

$\Leftrightarrow$F(e) is a q-set in $(X,({}^{s}\tau)_{e})$

F is a soft Q-set$\Leftrightarrow {}^{s}Cl\,{}^{s}Int\mathrm{F}={}^{s}Int\,{}^{s}Cl\mathrm{F}$

$\Leftrightarrow({}^{s}Cl\,{}^{s}Int\mathrm{F})(e)=({}^{s}Int\,{}^{s}Cl\mathrm{F})(e)$ for every e∈E

$\Leftrightarrow ClInt(\mathrm{F}(e))=IntCl(\mathrm{F}(e))$

$\Leftrightarrow$F(e) is a Q-set in $(X, ({}^{s}\tau)_{e})$. Hence the proof is completed.

A soft topology and its α-soft topology have the same collection of soft ρ-sets as shown in the next proposition.

Proposition 3.6

Let(X, ${}^{s}\tau$, E) be a soft topological space with QS($({}^{s}\tau)_{e}$) is contained in ${}^{s}\tau$ for every e∈E and ${}^{s}\alpha$O(X, ${}^{s}\tau$, E) be the collection of soft α-open sets in (X, ${}^{s}\tau$, E).

Let $F \in S(X, E)$. Then F is a soft ρ-set in $(X, {}^s\tau, E)$ if and only ifFis a soft ρ-set in $(X, {}^s\alpha O(X, {}^s\tau, E), E)$.

Proof:

Fis a soft p-set⇔F(e) is a soft p-set in $(X, ({}^s\tau)_e)$ forevery $e \in E$.

$\Leftrightarrow (ClInt(F(e)) \subseteq (IntCl(F(e))$

$\Leftrightarrow ({}^s\alpha Cl{}^s\alpha Int F)(e) \subseteq ({}^s\alpha Int{}^s\alpha Cl F))(e)$

$\Leftrightarrow {}^s\alpha Cl{}^s\alpha Int F {}^s\subseteq {}^s\alpha Int{}^s\alpha Cl F$

⇔F is a soft p-set in $(X, {}^s\alpha O(X, {}^s\tau, E), E)$.

F is a soft q-set⇔F(e) is a soft q-set in $(X, ({}^s\tau)_e)$ for every $e \in E$.

$\Leftrightarrow (IntCl(F(e)) \subseteq (ClInt(F(e))$

$\Leftrightarrow (\alpha Int\alpha Cl(F(e)) \subseteq (\alpha Cl\alpha Int(F(e))$

$\Leftrightarrow \alpha Int\alpha Cl F \subseteq \alpha Cl\alpha Int F$

⇔F is a soft q-set in $(X, {}^s\alpha O(X, {}^s\tau, E), E)$.

F is a soft Q-set⇔F(e) is a soft Q-set in $(X, ({}^s\tau)_e)$ for every $e \in E$.

$\Leftrightarrow (ClInt(F(e)) = (IntCl(F(e))$

$\Leftrightarrow ({}^s\alpha Cl{}^s\alpha Int F)(e) = ({}^s\alpha Int{}^s\alpha Cl F))(e)$

$\Leftrightarrow {}^s\alpha Cl{}^s\alpha Int F = {}^s\alpha Int{}^s\alpha Cl F$

⇔F is a soft Q-set in $(X, {}^s\alpha O(X, {}^s\tau, E), E)$.This completes the proof of the proposition.

Proposition 3.7

SupposeF is soft $b^\#$-open. Then if F is soft open then it is soft regular closed. The converse is not true.

Proof:

SupposeF is soft $b^\#$-open.

If F is soft open then $F = {}^sCl{}^sInt F {}^s\cup {}^sInt{}^sCl F$

$= {}^sCl F {}^s\cup {}^sInt{}^sCl F$

$= {}^sCl F$

$= {}^sCl{}^sInt F$ that implies Fis soft regular closed. Hence the proof is completed.

Examples can be constructed to show that a soft regular closed set that is also soft $b^\#$-open is not soft open.

Let$(X, {}^s\tau, E)$ be a soft space given in Example 3.1.7.

Define the soft set F_5 as $F_5(\alpha)=\begin{cases}\{b,c,d\} & \text{for } \alpha = e\\ X & \text{otherwise}\end{cases}$. Then ${}^sCl\,{}^sInt F_5=F_5$ and ${}^sCl\,{}^sInt F_5 \;{}^s\cup\; {}^sInt\,{}^sCl F_5=F_5$ but ${}^sInt F_5=F_2$. Hence F_5 is soft regular closed andsoft $b^\#$-open in $(X, {}^s\tau, E)$ but not softopen.

The following proposition shows that a soft $b^\#$ -open set is soft α-openiff it is a soft Q-set.

Proposition 3.8

SupposeF is soft $b^\#$-open. Then F is soft α-open if and only if it is a soft Q-set.

Proof:

If F is soft α-open then

$F \;{}^s\subseteq {}^sInt\,{}^sCl\,{}^sInt F \;{}^s\subseteq {}^sCl\,{}^sInt F \;{}^s\subseteq {}^sCl\,{}^sInt F \;{}^s\cup\; {}^sInt\,{}^sCl F=F$ and

$F \;{}^s\subseteq {}^sInt\,{}^sCl\,{}^sInt F \;{}^s\subseteq {}^sInt\,{}^sCl F \;{}^s\subseteq {}^sCl\,{}^sInt F \;{}^s\cup\; {}^sInt\,{}^sCl F=F \Longrightarrow {}^sCl\,{}^sInt F={}^sInt\,{}^sCl F=F$ which proves that F is a soft Q-set.

Conversely let F be a softQ-set. Since F issoft $b^\#$-open it follows that ${}^sCl\,{}^sInt F={}^sInt\,{}^sCl F=F$ that implies ${}^sInt\,{}^sCl\,{}^sInt F={}^sInt\,{}^sCl F=F$ so that F is softα-open. This proves the proposition.

Proposition 3.9

SupposeF is soft $b^\#$-open. The following are equivalent

(i) F is soft semi-open.

(ii) F is a soft q-set.

(iii) F is soft regular closed.

Proof:

IfF is soft semi-open, then ${}^sCl\,{}^sInt F \;{}^s\subseteq {}^sCl\,{}^sInt F \;{}^s\cup\; {}^sInt\,{}^sCl F=F \;{}^s\subseteq {}^sCl\,{}^sInt F$ that implies ${}^sInt\,{}^sCl F \;{}^s\subseteq {}^sCl\,{}^sInt F=F$ so that F is soft regular closed and a soft q-set. This proves (i)$\Rightarrow$(ii) and (i)$\Rightarrow$(iii).

Since every soft regular closed set is soft semi-open (iii)$\Rightarrow$(i) follows. Now suppose F is a soft q-set. Then ${}^sInt\,{}^sCl F \;{}^s\subseteq {}^sCl\,{}^sInt F$. Since F is soft $b^\#$-open, it follows that $F={}^sCl\,{}^sInt F \;{}^s\cup\; {}^sInt\,{}^sCl F={}^sCl\,{}^sInt F$ so that F is soft semi-open. This proves (ii)$\Rightarrow$(i). This completes the proof.

Proposition 3.10

SupposeF is soft $b^\#$ -open. The following are equivalent

(i) F is soft pre-open.

(ii) F is a soft p-set.

(iii) F is soft regular open.

Proof:

If F is soft pre-open then ${}^{s}Int^{s}Cl\text{F} \,{}^{s}\!\subseteq {}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\cup {}^{s}Int^{s}Cl\text{F}=\text{F} \,{}^{s}\!\subseteq {}^{s}Int^{s}Cl\text{F}$ that implies ${}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\subseteq {}^{s}Int^{s}Cl\text{F}=\text{F}$ so that F is soft regular open and a soft p-set. This proves (i)⇒(ii) and (i)⇒(iii).

Since every soft regular open set is soft pre-open, (iii)⇒(i) follows. Now suppose F is a soft p-set. Then ${}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\subseteq {}^{s}Int^{s}Cl\text{F}$. Since F is soft $b^{\#}$-open, it follows that $\text{F}={}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\cup {}^{s}Int^{s}Cl\text{F}= {}^{s}Int^{s}Cl\text{F}$ so that F is soft pre-open. This proves (ii)⇒(i). Thus the proof is completed.

A soft *b-open set in the soft topology is soft α-closediff it is soft closed and soft open in the soft topology as shown in the next proposition.

Proposition 3.11

SupposeFis soft *b-open. F is soft α-closed iff it is soft closed and soft open.

Proof:

SupposeF is soft *b -open. Then $\text{F} \,{}^{s}\!\subseteq {}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\cap {}^{s}Int^{s}Cl\text{F}$.

If F is soft α-closed then $\text{F} \,{}^{s}\!\subseteq {}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\cap {}^{s}Int^{s}Cl\text{F} \,{}^{s}\!\subseteq {}^{s}Cl^{s}Int^{s}Cl\text{F} \,{}^{s}\!\subseteq \text{F}$ so that $\text{F}={}^{s}Cl^{s}Int^{s}Cl\text{F}$ that implies F is soft closed so that $\text{F} \,{}^{s}\!\subseteq {}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\cap {}^{s}Int\,\text{F}= {}^{s}Int\,\text{F}$ which shows thatF is soft open. The converse part is trivial.

Proposition 3.12

SupposeF is soft *b-open. Consider the following statements.

(i) F is soft semi-closed

(ii) F is a soft q-set

(iii) F is soft regular open

(iv) F is soft pre-open

Then (i)⇒(ii), (i)⇔(iii), (ii)⇒(iv) and (iii)⇒(iv) always hold.

Proof:

If F is soft semi-closed then $\text{F} \,{}^{s}\!\subseteq {}^{s}Cl^{s}Int\text{F} \,{}^{s}\!\cap {}^{s}Int^{s}Cl\text{F} \,{}^{s}\!\subseteq {}^{s}Int^{s}Cl\text{F} \,{}^{s}\!\subseteq \text{F}$sothat $\text{F}={}^{s}Int^{s}Cl\text{F} \,{}^{s}\!\subseteq {}^{s}Cl^{s}Int\text{F}$ that implies F is soft regular open and a soft q-set. This proves (i)⇒(iii) and (i)⇒(ii).

Since every soft regular open set is soft semi-closed (iii)⇒(i) is established. Now suppose F is a soft q-set. Then $Int^s Cl F \,^s\subseteq^s Cl^s Int F$. Since Fis soft*b-open it follows that F $^s\subseteq^s Cl^s Int F^s \cap^s Int^s Cl F = ^s Int^s Cl F$ so that F is soft pre-open.

Proposition 3.13

SupposeF is soft *b-open. Consider the following statements.

(i) F is soft pre-closed.

(ii) F is a soft p-set.

(iii) F is soft regular closed.

(iv) F is soft semi-open.

Then (i)⇒(ii), (i)⇔(iii) , (ii)⇒(iv) and (iii)⇒(iv) always hold.

Proof:

If F is soft pre-closed then F $^s\subseteq^s Cl^s Int F \,^s\cap^s Int^s Cl F^s\subseteq^s Cl^s Int F^s\subseteq F$ so that $F=^s Cl^s Int F \,^s\subseteq^s Int^s Cl F$ that implies F is soft regular closed and a soft p-set. This proves (i)⇒(iii) and (i)⇒(ii).

Since every soft regular closed set is soft pre-closed (iii)⇒(i) is proved. Now suppose F_E is a soft p-set. Then $^s Cl^s Int F \,^s\subseteq^s Int^s Cl F$. Since F is soft *b-open it follows that F $^s\subseteq^s Cl^s Int F \,^s\cap^s Int^s Cl F = \,^s Cl^s Int F$so that F is soft semi-open.

IV. CONCLUSION

In this paper, soft p-set, soft q-set, soft Q-set and their operators are characterized by the parametrized family of topologies induced by the soft topology.

References:

[1] A.Aygunoglu, H.Aygun, Some notes on soft topological spaces, Neural Comput&Applic21(1) (2012), 113-119.

[2] P. EvanzalinEbenanjar and Dr. P.Thangavelu, "Between Nearly open sets and Soft Nearly open sets", Appl. Math. Inf. Sci. 10, No. 6, 1-5(2016).

[3] Hussain S and Ahmad B, Some properties of soft topological spaces, *Computers and Mathematics with Applications*, 62(2011), 4058-4067.

[4] D. Molodtsov, Soft set theory first results, Comput. Math.Appl. 37 (1999), 19-31.

[5] Muhammad Shabir, MunazzaNaz, On Soft topological spaces, Comput. Math. Appl. 61 (2011), 1786-1799.

[6] Thangavelu P and Rao K C, p-sets in topological spaces, *Bulletion of pure and Applied Sciences*, 21(E) (2) (2002), 341-355.

[7] Thangavelu P and Rao K C, q-sets in topological spaces, *Prog. ofMaths,* vol.36 (Nos.1&2) (2002).

[8] I.Zorlutuna,M.Akdag,W.K.Min,S.Atmaca, Remarks on soft topological spaces, Annals of Fuzzy Mathematics and Informatics 3(2)(2012), 171-185.