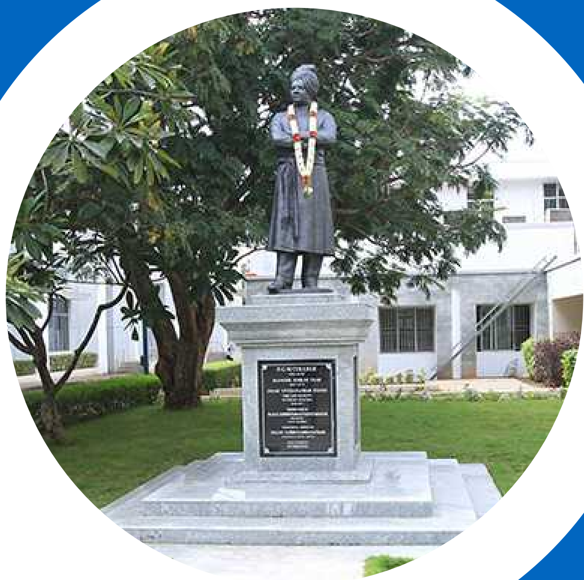
VOLUME XI
ISBN No.: 978-93-94004-00-9
Physical Science

Estd. 1957

NALLAMUTHU GOUNDER MAHALINGAM COLLEGE

An Autonomous Institution, Affiliated to Bharathiar University, An ISO 9001:2015 Certified Institution,

Pollachi-642001



SUPPORTED BY

ABT Industries Ltd.,
Dairy Division

PROCEEDING

One day International Conference

EMERGING TRENDS IN SCIENCE AND TECHNOLOGY (ETIST-2021)

27th October 2021

Jointly Organized by

Department of Biological Science, Physical Science and Computational Science

NALLAMUTHU GOUNDER MAHALINGAM COLLEGE

An Autonomous Institution, Affiliated to Bharathiar University

An ISO 9001:2015 Certified Institution, Pollachi-642001.

Estd. 1957

Proceeding of the

One day International Conference on

EMERGING TRENDS IN SCIENCE AND TECHNOLOGY (ETIST-2021)

27th October 2021

Jointly Organized by

Department of Biological Science, Physical Science and Computational Science

Copyright © 2021 by Nallamuthu Gounder Mahalingam College

All Rights Reserved

ISBN No: 978-93-94004-00-9

978- 93- 94004- 00- 9

Nallamuthu Gounder Mahalingam College

An Autonomous Institution, Affiliated to Bharathiar University

An ISO 9001:2015 Certified Institution, 90 Palghat Road, Pollachi-642001.

www.ngmc.org

ABOUT THE INSTITUTION

A nations's growth is in proportion to education and intelligence spread among the masses. Having this idealistic vision, two great philanthropists late. S.P. Nallamuthu Gounder and Late. Arutchelver Padmabhushan Dr.N.Mahalingam formed an organization called Pollachi Kalvi Kazhagam, which started NGM College in 1957, to impart holistic education with an objective to cater to the higher educational needs of those who wish to aspire for excellence in knowledge and values. The College has achieved greater academic distinctions with the introduction of autonomous system from the academic year 1987-88. The college has been Re-Accredited by NAAC and it is ISO 9001 : 2015 Certified Institution. The total student strength is around 6000. Having celebrated its Diamond Jubilee in 2017, the college has blossomed into a premier Post-Graduate and Research Institution, offering 26 UG, 12 PG, 13 M.Phil and 10 Ph.D Programmes, apart from Diploma and Certificate Courses. The college has been ranked within Top 100 (72nd Rank) in India by NIRF 2021.

ABOUT CONFERENCE

The International conference on “Emerging Trends in Science and Technology (ETIST-2021)” is being jointly organized by Departments of Biological Science, Physical Science and Computational Science - Nallamuthu Gounder Mahalingam College, Pollachi along with ISTE, CSI, IETE, IEE & RIYASA LABS on 27th OCT 2021. The Conference will provide common platform for faculties, research scholars, industrialists to exchange and discus the innovative ideas and will promote to work in interdisciplinary mode.

EDITORIAL BOARD

Dr. V. Inthumathi

Associate Professor & Head, Dept. of Mathematics, NGM College

Dr. J. Jayasudha

Assistant Professor, Dept. of Mathematics, NGM College

Dr. R. Santhi

Assistant Professor, Dept. of Mathematics, NGM College

Dr. V. Chitra

Assistant Professor, Dept. of Mathematics, NGM College

Dr. S. Sivasankar

Assistant Professor, Dept. of Mathematics, NGM College

Dr. S. Kaleeswari

Assistant Professor, Dept. of Mathematics, NGM College

Dr. N.Selvanayaki

Assistant Professor, Dept. of Mathematics, NGM College

Dr. M. Maheswari

Assistant Professor, Dept. of Mathematics, NGM College

Mrs. A. Gnanasoundari

Assistant Professor, Dept. of Mathematics, NGM College

Dr. A.G. Kannan

Assistant Professor, Dept. of Physics, NGM College

New class of generalized closed sets in soft topological spaces

N. Selvanayaki[1], **Gnanambal Ilango**[2] and **M.Maheswari**[3].

Abstract - In this paper, we introduce the notions of α-generalized regular weakly closed sets and α-generalized regular weakly open sets in soft topological spaces and some of its properties are studied.

Keywords *Soft sets, soft topological spaces, soft αgrw-closed sets and soft αgrw-open sets.*
2010 Subject classification: *54A05, 54A10.*

1 Introduction and Preliminaries

The concept of soft sets was first introduced by Molodtsov[7] in 1999 who began to develop the basics of corresponding theory as a new approach to modeling uncertainties. In Molodtsov 2006, [8] successfully applied the soft theory in several directions such as Smoothness of functions, Game theory, Operations research, Riemann integration, Perron integration, Probability and Theory of measurement.

In recent years, an increasing number of papers have been written about soft sets theory and its applications in various fields [9, 16]. Shabir and Naz [14] introduced the notion of soft topological spaces which are defined to be over an initial universe with a fixed set of parameters. In addition Maji et al. [10] proposed several operations on soft sets and some basic properties of these operations have been revealed so far.

In 2012, generalized closed set was introduced by Kannan[6] in soft topological spaces. Selvanayaki and Gnanambal Ilango[13] introduced the concept of α-generalized regular weakly closed sets in topological spaces in the year 2013. In this paper soft α-generalized regular weakly closed sets are introduced in soft topological spaces. Further we investigate some soft topological properties of this set.

Definition 1.1. *[7] Let U be an initial universe set and E be a set of parameters. Let $P(U)$ denotes the power set of U and $A \subseteq E$. A pair (F, A) is called a soft set over U, where F is a mapping given by $F : A \to P(U)$.*

[1]Assistant Professor, Department of Mathematics, Nallamuthu Gounder Mahalingam College, Pollachi-642001, Coimbatore, Tamilnadu, India.
E.mail: selvanayaki.nataraj@gmail.com
[2]Assistant Professor, Department of Mathematics, Government Arts College, Coimbatore, Tamilnadu, India.
E.mail: gnanamilango@yahoo.co.in
[3]Assistant Professor, Department of Mathematics, Nallamuthu Gounder Mahalingam College, Pollachi-642001, Coimbatore, Tamilnadu, India.
E.mail: mahimrk@gmail.com

Definition 1.2. *[10] Let U be an universal set and E be an universe set of parameters. Let (F, A) and (G, B) be soft sets over a common universe set U and $A, B \subseteq E$. Then (F, A) is a subset of (G, B), denoted by $(F, A) \subseteq (G, B)$, if*
(i) $A \subseteq B$,
(ii) for all $e \in E, F(e) \subseteq G(e)$.
(F, A) equals (G, B), denoted by $(F, A) = (G, B)$, if $(F, A)\widetilde{\subseteq}(G, B)$ and $(G, B)\widetilde{\subseteq}(F, A)$.
We denote the family of these soft sets by $SS(X)_E$.

Definition 1.3. *[10] Two soft set (F, A) and (G, B) over a common universe U are said to be equal if (F, A) is a soft subset of (G, B) and (G, B) is a soft subset of (F, A).*

Definition 1.4. *[10] A soft set (F, A) over U is said to be a null soft set, denoted by $\widetilde{\phi}$, if $\forall \epsilon \in A, F(\epsilon) = \phi$.*

Definition 1.5. *[10] A soft set (F, A) over U is said to be a absolute soft set, denoted by $\widetilde{U}$, if $\forall \epsilon \in A, F(\epsilon) = U$,*

Definition 1.6. *[10] Union of two soft sets of $F, A)$ and (G, B) over the common universe U is the soft set (H, C), where $C = A \cup B$, and $\forall e \in C$,*

$$H(e) = \begin{cases} F(e), \textit{if } e \in A - B \\ G(e), \textit{if } e \in B - A \\ F(e) \cup G(e), \textit{if } e \in A \cap B \end{cases}$$

Definition 1.7. *[10] Intersection of two soft sets (F, A) and (G, B) over the common universe U is the soft set (H, C), where $C = A \cap B$, and $\forall e \in C$, $H(e) = F(e)$ or $G(e)$. We write $(F, A) \widetilde{\cap} (G, B) = (H, C)$.*

Definition 1.8. *[2] The complement of a soft set (F, A), denoted by $(F, A)^c$, is defined by $(F, A)^c = (F^c, A), F^c : A \to P(X)$ is mapping given by $F^c(e) = X - F(e), \forall e \in A$ and F^c is called the soft complement function of F.*

Definition 1.9. *[10] A soft set (E, A) over X is said to be soft element if there exists $\alpha \in A$ such that $E(\alpha)$ is a singleton, say $\{x\}$, and $E(\beta) = \phi$, $\forall\ \beta(\neq \alpha) \in A$, such a soft element is denoted by E^x_α.*

Definition 1.10. *[14] Let $\widetilde{\tau}$ be the collection of soft sets over X. Then $\widetilde{\tau}$ is said to be a soft topology on X if*

(i) $(\widetilde{\phi}, A), (\widetilde{X}, A) \widetilde{\in} \widetilde{\tau}$, where $\widetilde{\phi}(\alpha) = \phi$ and $\widetilde{X}(\alpha) = X, \quad \forall A$,

(ii) the intersection of any two soft sets in $\widetilde{\tau}$ belongs to $\widetilde{\tau}$,

(iii) the union of any number of soft sets in $\widetilde{\tau}$ belongs to $\widetilde{\tau}$.
The triple $(X, \widetilde{\tau}, A)$ is called a soft topological space over X. The members of $\widetilde{\tau}$ are said to be soft open sets in X.

Definition 1.11. *Let $(X, \widetilde{\tau}, E)$ be a soft topological space over X and (A, E) be a soft set in $(X, \widetilde{\tau}, E)$ is called*

(a) soft semi open [3] $(A, E) \widetilde{\subseteq} cl_s(int_s(A, E))$ and soft semi closed $int_s(cl_s(A, E)) \widetilde{\subseteq}$ (A, E).

(b) soft pre open [4] $(A, E) \widetilde{\subseteq} int_s(cl_s(A, E))$ and soft pre closed $cl_s(int_s(A, E)) \widetilde{\subseteq} (A, E)$.

(c) soft regular open [12] $(A, E) = int_s(cl_s(A, E))$ and soft regular closed $(A, E) = cl_s(int_s(A, E))$.

(d) soft α-open [1] $(A, E) \widetilde{\subseteq} int_s(cl_s(int_s(A, E)))$ and soft α-closed if $cl_s(int_s(cl_s(A, E))) \widetilde{\subseteq} (A, E)$.

Definition 1.12. *[15] In a soft topological space $(X, \widetilde{\tau}, E)$, a soft set (G, C) is said to be regular semi-open soft set if there is a regular open soft set (H, B) such that $(H, B) \widetilde{\subseteq} (G, C) \widetilde{\subseteq} cl_s(H, B)$*

Definition 1.13. *A soft set (A, E) of a soft topological space $(X, \widetilde{\tau}, E)$ is called*

(a) a soft ω-closed [11] if $cl_s(A, E) \widetilde{\subseteq} (U, E)$ whenever $(A, E) \widetilde{\subseteq} (U, E)$ and (U, E) is soft semi open in $(X, \widetilde{\tau}, E)$,

(c) a soft generalized pre regular closed (briefly soft gpr-closed)[5] if $pcl_s(A, E) \widetilde{\subseteq} (U, E)$ whenever $(A, E) \widetilde{\subseteq} (U, E)$ and (U, E) is soft regular open in $(X, \widetilde{\tau}, E)$,

2 Soft α-generalized regular weakly closed sets in soft topological spaces

Definition 2.1. *A soft set (A, E) in a soft topological space $(X, \widetilde{\tau}, E)$ is called a soft α- generalized regular weakly closed (briefly soft αgrw-closed) set in $(X, \widetilde{\tau}, E)$ if $\alpha cl_s((A, E)) \widetilde{\subseteq} (U, E)$ whenever $(A, E) \widetilde{\subseteq} (U, E)$ and (U, E) is soft regular semi-open in $(X, \widetilde{\tau}, E)$.*

Example 2.2. *Let $X = \{x_1, x_2\}$, $E = \{e_1, e_2\}$ and $\widetilde{\tau} = \{ \widetilde{\phi}, \widetilde{X}, (F_1, E), (F_2, E), (F_3, E)\}$ where $(F_1, E), (F_2, E), (F_3, E)$ are soft sets over (X, E), defined as follows*
$F_1(e_1) = \{\phi\}$, $F_1(e_2) = \{x_1\}$,
$F_2(e_1) = \{x_1\}$, $F_2(e_2) = \{x_2\}$,
$F_3(e_1) = \{x_1\}$, $F_3(e_2) = \{X\}$.
Then a soft set (A, E) such that $A(e_1) = \{x_1\}$, $A(e_2) = \{x_1\}$ is a soft αgrw-closed set.

Proposition 2.3. *For a soft topological space $(X, \widetilde{\tau}, E)$, every soft closed (resp. soft α-closed, soft regular closed and soft ω-closed) set is soft αgrw-closed.*

Proof.

1. Let (A, E) be any soft closed set and (U, E) be soft regular semi-open such that $(A, E) \widetilde{\subseteq} (U, E)$. Since every soft closed set is soft α-closed, $\alpha cl_s((A, E)) \widetilde{\subseteq} cl_s((A, E)) = (A, E)$. Thus $\alpha cl_s((A, E)) \widetilde{\subseteq} (U, E)$ and so (A, E) is soft αgrw-closed.

2. Let (A, E) be soft α-closed set and (U, E) be soft regular semi-open such that $(A, E) \widetilde{\subseteq} (U, E)$. Then $\alpha cl_s((A, E)) = (A, E) \widetilde{\subseteq} (U, E)$. Hence (A, E) is soft αgrw-closed.

3. Let (A, E) be soft regular closed set and (U, E) be soft regular semi-open such that $(A, E) \widetilde{\subseteq} (U, E)$. Then (A, E) is soft αgrw-closed, since every soft regular closed set is soft closed and by 1.

4. Let (A, E) be soft ω-closed set and (U, E) be soft regular semi-open such that $(A, E) \widetilde{\subseteq} (U, E)$. Since every soft regular semi-open set is soft semi open, $\alpha cl_s((A, E)) \widetilde{\subseteq} cl_s((A, E)) \widetilde{\subseteq} (U, E)$. Hence (A, E) is soft αgrw-closed.

Proposition 2.4. *In a soft topological space $(X, \widetilde{\tau}, E)$, every soft αgrw-closed set is soft gpr-closed.*

Proof. Let (A, E) be soft αgrw-closed and (U, E) be soft regular open such that $(A, E) \widetilde{\subseteq} (U, E)$. Since every soft regular open is soft regular semi-open and every α-closed set is semi pre closed, we have $spcl_s((A, E)) \widetilde{\subseteq} \alpha cl_s((A, E))) \widetilde{\subseteq} (U, E)$. Hence (A, E) is soft gpr-closed.

Remark 2.5. *The converses of the above propositions need not be true as seen from the following examples.*

Example 2.6. *In Example 2.2, (A, E) is soft αgrw-closed but not soft closed, not soft α-closed, not soft regular closed and not soft ω-closed.*

Example 2.7. *In Example 2.2, $\{(e_1, \{\phi\}), (e_2, \{x_2\})\}$ is soft gpr-closed but not soft αgrw-closed.*

Proposition 2.8. *If (A, E) and (B, E) are soft αgrw-closed sets, then $(A, E) \widetilde{\cup} (B, E)$ is soft αgrw-closed.*

Proof. Suppose that $(A, E) \widetilde{\cup} (B, E) \widetilde{\subseteq} (U, E)$ and (U, E) is soft regular semi-open. Then $(A, E) \widetilde{\subseteq} (U, E)$ and $(B, E) \widetilde{\subseteq} (U, E)$. Since (A, E) and (B, E) are soft αgrw-closed, $\alpha cl_s((A, E)) \widetilde{\subseteq} (U, E)$ and $\alpha cl_s((B, E)) \widetilde{\subseteq} (U, E)$ and hence $\alpha cl_s((A, E) \widetilde{\cup} (B, E)) = \alpha cl_s((A, E)) \widetilde{\cup} \alpha cl_s((B, E)) \widetilde{\subseteq} (U, E)$. Thus $(A, E) \widetilde{\cup} (B, E)$ is soft αgrw-closed.

Remark 2.9. *The intersection of two soft αgrw-closed sets of a soft topological space $(X, \widetilde{\tau}, E)$ is generally not soft αgrw-closed.*

Example 2.10. *In Example 2.2, the soft sets $\{(e_1, \{x_1\}), (e_2, \{x_1\})\}$ and $\{(e_1, \{x_2\}), (e_2, \{x_1\})\}$ are soft αgrw-closed but their intersection $\{(e_1, \{\phi\}), (e_2, \{x_1\})\}$ is not soft αgrw-closed.*

Proposition 2.11. *If (A, E) is soft αgrw-closed subset of $(X, \widetilde{\tau}, E)$ such that $(A, E) \widetilde{\subseteq} (B, E) \widetilde{\subseteq} \alpha cl_s((A, E))$, then (B, E) is soft αgrw-closed set in $(X, \widetilde{\tau}, E)$.*

Proof. Let (A, E) be soft αgrw-closed subset of $(X, \widetilde{\tau}, E)$ such that $(A, E) \widetilde{\subseteq} (B, E) \widetilde{\subseteq} \alpha cl_s((A, E))$. Let $(B, E) \widetilde{\subseteq} (U, E)$ and (U, E) is soft regular semi-open. Then $(A, E) \widetilde{\subseteq} (U, E)$. Since (A, E) is soft αgrw-closed, $\alpha cl_s((A, E)) \widetilde{\subseteq} (U, E)$. Now $\alpha cl_s((B, E)) \widetilde{\subseteq} \alpha cl_s(\alpha cl_s((A, E))) = \alpha cl_s((A, E)) \widetilde{\subseteq} (U, E)$. Therefore (B, E) is soft αgrw-closed sets in $(X, \widetilde{\tau}, E)$.

Remark 2.12. *The converse of the above proposition need not be true. In Example 2.2, the sets $(A, E) = \{(e_1, \{x_2\}), (e_2, \{\phi\})\}$ and $(B, E) = \{(e_1, \{x_2\}), (e_2, \{x_1\})\}$ are soft αgrw-closed sets in $(X, \widetilde{\tau}, E)$. Here $\alpha cl_s((A, E)) = \{(e_1, \{x_2\}), (e_2, \{\phi\})\}$. Therefore $(A, E) \widetilde{\subseteq} (B, E) \widetilde{\nsubseteq} \alpha cl_s((A, E))$. Thus any soft αgrw-closed set need not lie between αgrw-closed and its soft αclosure.*

Corollary 2.13. *Every soft regular semi-open set is soft regular semi-closed.*

Proof. Let (A, E) be soft regular semi-open and (B, E) be a soft regular closed set in $(X, \widetilde{\tau}, E)$. Then $int_s((B, E))$ is soft regular open and so by assumption $int_s((B, E)) \widetilde{\subseteq} (A, E) \widetilde{\subseteq} cl_s(int_s((B, E))) = (B, E)$. This implies (A, E) is soft regular semi-closed.

Proposition 2.14. *If a soft subset (A,E) of $SS(X)_E$ is soft αgrw-closed, then $\alpha cl_s((A,E))-(A,E)$ does not contain any non empty soft regular semi-open set.*

Proof. Let (A,E) be soft αgrw-closed set in $(X,\widetilde{\tau},E)$. Let (U,E) be an non empty soft regular semi-open set such that $(U,E)\widetilde{\subseteq}\alpha cl_s((A,E))-(A,E)$. Now, $(U,E)\widetilde{\subseteq}(A^c,E)$ which implies $(A,E)\widetilde{\subseteq}(U^c,E)$. Since (U,E) is regular semi-open, (U^c,E) is regular semi-open by Corollary 2.13. Since (A,E) is soft αgrw-closed in $(X,\widetilde{\tau},E)$, $\alpha cl_s((A,E))\widetilde{\subseteq}(U^c,E)$. So $(U,E)\subseteq[\alpha cl_s((A,E))]^c$ and also $(U,E)\widetilde{\subseteq}\alpha cl_s((A,E))$. Therefore $(U,E)\widetilde{\subseteq}\alpha cl_s((A,E))\widetilde{\cap}[\alpha cl_s((A,E))]^c=\widetilde{\phi}$, which is a contradiction. Hence $\alpha cl_s((A,E))-(A,E)$ does not contain any non empty soft regular semi-open set in $(X,\widetilde{\tau},E)$.

Remark 2.15. *The converse of the above proposition need not be true. In Example 2.2, let* $(A,E)=\{(e_1,\{x_1\}),(e_2,\{\phi\})\}$. *Then* $\alpha cl_s((A,E))-(A,E)=\{(e_1,\{X\}),(e_2,\{x_2\})\}-\{(e_1,\{x_1\}),(e_2,\{\phi\})\}=\{(e_1,\{x_2\}),(e_2,\{x_2\})\}$ *does not contain non empty soft regular semi-open set, but (A,E) is not a soft αgrw-closed set in $(X,\widetilde{\tau},E)$.*

Corollary 2.16. *If a soft subset (A,E) of $SS(X)_E$ is soft αgrw-closed, then $\alpha cl_s((A,E))-(A,E)$ does not contain any non empty soft regular semi-closed set.*

Proposition 2.17. *If a soft subset (A,E) of $SS(X)_E$ is soft αgrw-closed, then $\alpha cl_s((A,E))-(A,E)$ does not contain any non empty soft regular closed set.*

Proof. Let (A,E) be soft αgrw-closed set in $(X,\widetilde{\tau},E)$ and (F,E) be a soft regular closed subset of $\alpha cl_s((A,E))-(A,E)$. Then $(A,E)\widetilde{\subseteq}(F^c,E)$. Since every soft regular open set is soft regular semi-open and (A,E) is soft αgrw-closed, $\alpha cl_s((A,E))\widetilde{\subseteq}(F^c,E)$. Consequently $(F,E)\widetilde{\subseteq}[\alpha cl_s((A,E))]^c$. Thus $(F,E)\widetilde{\subseteq}\alpha cl_s((A,E))\widetilde{\cap}[\alpha cl_s((A,E))]^c=\widetilde{\phi}$. Hence $\alpha cl_s((A,E))-(A,E)$ contains no non empty soft regular closed set.

Remark 2.18. *The converse of the above proposition need not be true. In Example 2.2, let* $(A,E)=\{(e_1,\{x_1\}),(e_2,\{\phi\})\}$. *Then* $\alpha cl_s((A,E))-(A,E)=\{(e_1,\{x_2\}),(e_2,\{x_2\})\}$ *does not contain non empty soft regular closed set, but (A,E) is not a soft αgrw-closed set.*

Proposition 2.19. *Let (A,E) be a soft αgrw-closed set in $(X,\widetilde{\tau},E)$. Then (A,E) is soft α-closed if and only if $\alpha cl_s((A,E))-(A,E)$ is soft regular semi-open in $(X,\widetilde{\tau},E)$.*

Proof. Suppose (A,E) is soft α-closed. Then $\alpha cl_s((A,E))=(A,E)$ and so $\alpha cl_s((A,E))-(A,E)=\widetilde{\phi}$, which is soft regular semi-open in $(X,\widetilde{\tau},E)$.

Conversely, suppose that (A,E) is soft αgrw-closed and $\alpha cl_s((A,E))-(A,E)$ is soft regular semi-open. Since (A,E) is soft αgrw-closed by Proposition 2.14, $\alpha cl_s((A,E))-(A,E)$ does not contain any non empty soft regular semi-open in $(X,\widetilde{\tau},E)$. Then $\alpha cl_s((A,E))-(A,E)=\widetilde{\phi}$. Therefore $\alpha cl_s((A,E))=(A,E)$. Hence (A,E) is soft α-closed.

Remark 2.20. *A soft singleton set of $SS(X)_E$ is denoted by $\{x\}_e,\forall e\in E,x\in X$.*

Proposition 2.21. *For each $X_e^x\widetilde{\in}SS(X)_E$, where X_e^x is a soft element of $SS(X)_E$ either $\{x\}_e$ is soft regular semi-closed or $X-\{x\}_e$ is soft αgrw-closed in $(X,\widetilde{\tau},E)$.*

Proof. Suppose that $\{x\}_e$ is not regular semi-closed in $(X,\widetilde{\tau},E)$. Then $X-\{x\}_e$ is not regular semi-open and the only regular semi-open set containing $X-\{x\}_e$ is $\widetilde{X}$ itself. Therefore $\alpha cl_s((X-\{x\}_e))\widetilde{\subseteq}\widetilde{X}$ and so $X-\{x\}_e$ is soft αgrw-closed in $(X,\widetilde{\tau},E)$.

Corollary 2.22. *For an element $X_e^x \widetilde{\in} SS(X)_E$ the set $X - \{x\}_e$ is soft αgrw-closed or soft regular semi-open.*

Proof. Suppose that $X - \{x\}_e$ is not soft regular semi-open. Then $\widetilde{X}$ is the only soft regular semi-open containing $X - \{x\}_e$ and also $\alpha cl_s((X - \{x\}_e)) \widetilde{\subseteq} \widetilde{X}$. Hence $X - \{x\}_e$ is soft αgrw-closed set in $(X, \widetilde{\tau}, E)$.

Definition 2.23. *A soft subset (A, E) is called a soft α-generalized regular weakly open (briefly soft αgrw-open) set in a soft topological space$(X, \widetilde{\tau}, E)$ if (A^c, E) is soft αgrw-closed.*

Proposition 2.24. *For a soft topological space $(X, \widetilde{\tau}, E)$, every soft open (resp. soft α-open, soft regular open and soft ω-open) set is soft αgrw-open.*

Proof. Obvious

Theorem 2.25. *A soft subset (A, E) of $SS(X)_E$ is soft αgrw-open if and only if $(F, E) \widetilde{\subseteq} \alpha int_s((A, E))$ whenever (F, E) is soft regular semi-closed and $(F, E) \widetilde{\subseteq} (A, E)$.*

Proof. Suppose that $(F, E) \widetilde{\subseteq} \alpha int_s((A, E))$ whenever (F, E) is soft regular semi-closed and $(F, E) \widetilde{\subseteq} (A, E)$. Let $(A^c, E) \widetilde{\subseteq} (U, E)$, where (U, E) is soft regular semi-open. Then $(U^c, E) \widetilde{\subseteq} (A, E)$, where (U^c, E) is soft regular semi-closed. By hypothesis $(U^c, E) \widetilde{\subseteq} \alpha int_s((A, E))$, which implies $(\alpha int_s((A, E))^c \widetilde{\subseteq} (U, E)$. That is $\alpha cl_s((A^c, E)) \widetilde{\subseteq} (U, E)$. Thus (A^c, E) is soft αgrw-closed. Hence (A, E) is soft αgrw-open.

Conversely, suppose that (A, E) is soft αgrw-open, $(F, E) \widetilde{\subseteq} (A, E)$ and (F, E) is soft regular semi-closed. Then (F^c, E) is soft regular semi-open and $(A^c, E) \widetilde{\subseteq} (F^c, E)$. Therefore $\alpha cl_s((A^c, E)) \widetilde{\subseteq} (F^c, E)$ and so $(F, E) \widetilde{\subseteq} (\alpha cl_s((A^c, E)))^c = \alpha int_s((A, E))$. Hence $(F, E) \widetilde{\subseteq} \alpha int_s((A, E))$.

Proposition 2.26. *If (A, E) and (B, E) are soft αgrw-open sets, then $(A, E) \widetilde{\cap} (B, E)$ is soft αgrw-open.*

Proof. Proofs follows from Proposition 2.8

Remark 2.27. *The union of two soft αgrw-open sets of a soft topological space $(X, \widetilde{\tau}, E)$ is generally not soft αgrw-open set. In Example 2.2, the soft sets $\{(e_1, \{x_2\}), (e_2, \{x_2\})\}$ and $\{(e_1, \{x_1\}), (e_2, \{\phi\}\}$ are soft αgrw-open sets but their union $\{(e_1, \{X\}), (e_2, \{x_2\})\}$ is not soft αgrw-open.*

Theorem 2.28. *For a subset (A, E) and (U, E) of $SS(X)_E$, the following are equivalent:*

(a) $cl_s((A, E)) - (A, E)$ *is soft αgrw-closed.*

(b) $(A, E) \widetilde{\cup} (cl_s((A, E)))^c$ *is soft αgrw-open.*

Proof. $(a) \Rightarrow (b)$. Let $(U, E) = cl_s((A, E)) - (A, E)$. Then $(U^c, E) = (A, E) \widetilde{\cup} (cl_s((A, E)))^c$ and $(A, E) \widetilde{\cup} (cl_s((A, E)))^c$ is soft αgrw-open.

$(b) \Rightarrow (a)$. Let $(U, E) = (A, E) \widetilde{\cup} (cl_s((A, E)))^c$. Then (U^c, E) is soft αgrw-closed and $(U^c, E) = cl_s((A, E)) - (A, E)$ and so $cl_s((A, E)) - (A, E)$ is soft αgrw-closed.

Proposition 2.29. *If a soft subset (A, E) is soft αgrw-open in $(X, \widetilde{\tau}, E)$, then $(U, E) = \widetilde{X}$ whenever (U, E) is soft regular semi-open and $\alpha int_s((A, E)) \widetilde{\subseteq} (A^c, E) \widetilde{\subseteq} (U, E)$.*

Proof. Assume that (A, E) is soft αgrw-open, (U, E) be soft regular semi-open such that $\alpha int_s((A, E)) \widetilde{\cup} (A^c, E)$
This implies $(U^c, E) \widetilde{\subseteq} (\alpha int_s((A, E)) \widetilde{\cup} (A^c, E))^c$
$= \alpha cl_s((A^c, E)) - (A^c, E)$. Since (A^c, E) is soft αgrw-closed and (U^c, E) is soft regular semi-closed by Corollary 2.16 , it follows that $(U^c, E) = \widetilde{\phi}$. Hence $\widetilde{X} = (U, E)$.

Proposition 2.30. *If (A, E) is soft αgrw-closed then $\alpha cl_s((A, E)) - (A, E)$ is soft αgrw-open.*

Proof. Suppose that (A, E) is soft αgrw-closed. Let $(F, E) \widetilde{\subseteq} \alpha cl_s((A, E)) - (A, E)$, where (F,E) is soft regular semi-closed. By Corollary 2.16, $(F, E) = \widetilde{\phi}$. Therefore $(F, E) \widetilde{\subseteq} \alpha int_s(\alpha cl_S((A, E)) - (A, E))$ and by Theorem 2.25, $\alpha cl_s((A, E)) - (A, E)$ is soft αgrw-open.

References

[1] M. Akdag and Al. Ozkan, *Soft α-open sets and soft α-continuous functions*, Abstr. Anal. Appl. Art ID 891341 (2014), 1-7.

[2] M.I. Ali, F. Feng, X. Liu, W.K. Min,M. Shabir, *On some new operations in soft set theory*, Computers and Mathematics with Applications **57** (2009), 1547-1553.

[3] Bin Chen, *Soft semi-open sets and related properties in soft topological spaces*, Appl. Math. Inf. Sci. **7(1)**(2013), 287-294.

[4] Gnanambal Ilango and Mrudula Ravindran, *On Soft Preopen Sets in Soft Topological Spaces*, International Journal of Mathematics Research**5(4)**(2013), 399-409.

[5] Z.E. Guzel, S. Yskel and N. Tozlu *On Soft generalized preregular closed and open sets in soft topological spaces*, Applied Mathematical Sciences **8**(2014), 7875-7884.

[6] K. Kannan *Soft generalized closed sets in soft topological spaces,*, J. of Theoretical and Appl. Inf. Tech. **37(1)**(2012), 17-21.

[7] D. Molodtsov, *Soft set theory -first results*, Computers and Mathematics with Applications, **37(4-5)**, (1999) 19-31.

[8] D. Molodtsov, V. Y. Leonov and D. V. Kovkov *Soft sets technique and its application*, Netchetkie Sistemyi Mygkie Vychisleniya, **1(1)**, (2006), 8-39.

[9] P. K. Maji, R. Biswas and A. R. Roy, *Fuzzy soft sets*, Journal of Fuzzy Mathematics, **9(3)**, (2001), 589-602.

[10] P. K.. Maji, R. Biswas and A. R. Roy, *Soft set theory*, Computers and Mathematics with Applications, **45(4-5)**, (2003), 555-562.

[11] Nirmala Rebecca Paul, *Remarks on soft ω-closed sets in soft topological spaces*, Bol. Soc. Paran. Mat. **33(1)** (2015), 183-192.

[12] Sabir Hussian, *On soft regular-open (closed) sets in soft topological spaces*, J. Appl. Math. and Informatics **36** (2018), No.1-2, 59-68.

[13] N. Selvanayaki and Gnanaambal Ilango *On α-generalized regular weakly closed sets in topological spaces*, Scientia Magna, **9(1)** (2013), 52-58.

[14] M. Shabir and M. Naz, *On soft topological spaces*, Computers and Mathematics with Applications, **617)**, (2011), 1786-1799.

[15] A. Vadivel and E. Elavarasan, *Regular semiopen soft sets and maps in soft topological spaces*, Annals of Fuzzy Mathematics and Informatics (2016), 1-15.

[16] I. Zorlutuna, M. Akdag, W.K. Min and S. Atmaca, *Remarks on soft topological spaces*,Annals of Fuzzy Mathematics and Informatics, **3(2)**, (2011), 171-185.

BIOGRAPHY

Dr. N. Selvanayaki is working as an Assistant Professor in the Department of Mathematics, Nallamuthu Gounder Mahalingam College, Pollachi. She has got her Doctoral degree in the field of Topology from Bharathiar University, Coimbatore. She has 13 years experience in teaching. She published 8 research papers in reputed journals.

Dr.Gnanambal Ilango, born on 8 th December 1968 took her doctoral degree in Mathematics during the year 1999 from Bharathiar University, Coimbatore. She completed M.Sc Mathematics at Alagappa University Karaikudi India during 1989-1991 and obtained first rank in Alagappa University. She also completed M.Phil during 1992-1993 at Alagappa University securing first rank.

She was a UGC-JRF from 1994-1996 and UGC-SRF from 1996 to 1999 at Bharathiar University. Presently she is working as Assistant Professor of Mathematics at Government Arts College, Coimbatore. Previously she served as Assistant Professor at Kumaraguru College of Technology, Coimbatore for nearly 10 years . Some of the publications include 1. N. Selvanayaki and Gnanambal Ilango, αgrw-separation axioms, Far East Journal of Mathematical Sciences, 99(7)(2016) 1037-1045. (SCOPUS) 2. Vidhya Menon and Gnanambal Ilango, On gpr^{μ}- closed mappings and gpr^{μ}-open mappings, East Asian Mathematical Journal, 33(5) (2017), 483-494.(SCI) 3. M. Thiruchelvi and Gnanambal ilango, Application of fuzzy topological relation in cyclone prediction, Malaya Journal of Matematik, S(1)(2020),81-85. She has done research in general topology and Intuitionistic topology. Now she is interested in working in Topological Data Analysis.

Dr. M. Maheswari is working as an Assistant Professor in the Department of Mathematics, Nallamuthu Gounder Mahalingam College, Pollachi. She has got her Doctoral degree in the field of Ideal bitopological spaces from Bharathiar University, Coimbatore. She has 6 years experience in teaching. She published 8 research papers in reputed journals.