α^{**}- CLOSED SETS IN TOPOLOGICAL SPACES

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Abstract: In this paper, we introduce a new class of sets namely, α** closed sets. Properties of this set are investigated and we introduce new spaces namely $T_{\alpha**}$ spaces, $_{\alpha g}T_{\alpha**}$ spaces,$_{gs}T_{\alpha**}$ spaces, $_{g}T_{\alpha**}$ spaces and $_{g*}T_{\alpha**}$ spaces.

Key words: α^{**}-closed set;$T_{\alpha**}$ spaces, $_{\alpha g}T_{\alpha**}$ spaces,$_{gs}T_{\alpha**}$ spaces, $_{g}T_{\alpha**}$ spaces and $_{g*}T_{\alpha**}$ spaces.

1.INTRODUCTION

Levine[7] introduced the class of g-closed set in 1970.maki.et.al[9] defined αg-closed sets in 1994.S.P.Arya and Tour [2] defined gs-closed sets in 1990.Dontchev [6] introduced gsp-closed sets .M.K.R.S Veerakumar [16] introduced and studied g^*-closed sets and g^*-continuity in topological spaces. The purpose of this paper is to introduce a new class of sets called α^{**}-closed sets and $T_{\alpha**}$ spaces, $_{\alpha g}T_{\alpha**}$spaces, $_{gs}T_{\alpha**}$ spaces, $_{g}T_{\alpha**}$ spaces and $_{g*}T_{\alpha**}$ spacesand investigate some of their properties.

1. PRELIMINARIES

Throughout this paper (X,τ) represents a non-empty topological space on whichno separation axioms are assumed unless otherwise mentioned.For a subset A of a space(X,τ),Cl(A),α Cl(A) and int(A) denote the closure, α closure and the interior of A respectively.

Definition: A subset A of a topology space (X,τ) is said to be

1.semi-closed[8] if int(Cl(A)) ⊆A.

2.g-closed[7] if Cl(A)⊆ U whenever A⊆U and U is open in X.

3. gs-closed[2] if Scl(A)⊆ U whenever A⊆U and U is open in X.

4. gp-closed[11] if Pcl(A)⊆ U whenever A⊆U and U is open in X.

5. α -closed[12] if Cl(int Cl(A)) ⊆A.

6.semi-pre closed[1] if int(Cl(int(A)) ⊆A.

7. gα -closed[10] if α Cl(A)⊆ U whenever A⊆U and U is α open in X.

8. α g-closed[9] if α Cl(A)⊆ U whenever A⊆U and U is open in X.

9.gsp-closed[6] if Spcl(A)⊆ U whenever A⊆U and U is open in X.

10.g^*-closed [16]if Cl(A)⊆ U whenever A⊆U and U is g-open in X.

11.$(g\alpha)^*$-closed[3] if α Cl(A)⊆ U whenever A⊆U and U is gα -open in X.

12. ω-closed[15] if Cl(A)⊆ U whenever A⊆U and U is semi-open in X.

13. ωg-closed[13] if cl(int A) ⊆ U whenever A⊆U and U is open in X.

14. $\overline{\psi}$ -closed[18] ifCl(A)⊆ U whenever A⊆U and U is sg-open in X.

15. $\overline{\psi}^*$ -closed[18] ifCl(A)⊆ U whenever A⊆U and U is $\overline{\psi}$ -open in X.

16. α^*-closed[17] ifCl(A)⊆ U whenever A⊆U and U is α -open in X.

17.g^{**}-closed[14] if Cl(A) ⊆ U whenever A⊆U and U is g^*-open in X.

Definition: A topological space (X, τ) is said to be a

1. $T_{1/2}$ space[7] if every g-closed set in it is closed.

2. T_b space[5] if every gs-closed set in it is closed.

3.T_d space[5] if every gs-closed set in it is g-closed.

4.$_\alpha T_d$ space[4] if every α g-closed set in it is g–closed.

5.$_\alpha T_b$space[4] if every α g-closed set in it is closed.

3. Basic properties of α^{**}-closed sets

We introduce the following definition.

Definition 3.1:A subset A of a topology space (X, τ) is said to be α^{**}-closed if Cl(A)⊆U whenever A⊆ U and U is α^{*} -open.

Proposition 3.2: Every closed set is α^{**}-closed.

Proof follows from the definition.

The converse of the above proposition need not true in general as seen in the following example.

Example3.3: Let X ={a,b,c}, τ ={ Φ ,X,{a}}.Then A={a,c} is α^{**} -closed but not closed in (X, τ).

Proposition 3.4: Every α^{**} -closed set is a g-closed set.

Proof: Let A be α^{**} -closed set. Let A⊆U where U is open. Then U is α^{*}-open. ThereforeCl(A)⊆U, since A is α^{**} -closed. Hence A is a g-closed set.

The converse of the above proposition need not true in general as seen in the following example.

Example 3.5: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}**.**Then A={a,b} is g-closed but not α^{**} -closed in (X, τ).

Proposition 3.6: Every α^{**} -closed set is a gs-closed set.

Proof: Let A be a α^{**} -closed set**.** Let A⊆U where U is open. Then U is α^{*}-open and Cl(A)⊆U, since A is α^{**}-closed**.** Scl(A)⊆Cl(A).Therefore Scl (A)⊆U, whenever A⊆U & U is open. Therefore A is a gs-closed set

The following example supports that a gs-closed set need not be α^{**} -closed in general.

Example 3.7: Let X={a,b,c}, τ ={(Φ ,X,{a},{b,c}}.Then A={c} is a gs-closed set but not α^{**}-closed in(X, τ).

Proposition 3.8: Every α^{**}- closed set is a gp-closed set.

Proof: Let A be a α^{**}- closed set. Let A⊆ U where U is open. since U is open, U is α^{*}-open. HenceCl(A)⊆ U ,since A is α^{**} -closed set. Pcl(A)⊆Cl(A).Therefore Pcl(A)⊆U, whenever A⊆U & U is open and hence A is a gp-closed set.

The converse of the above proposition need not true in general as seen in the following example.

Example 3.9: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then A={c} is gp-closed but not α^{**}- closed in (X, τ).

Proposition 3.10: Every α^{**}- closed set is α g- closed.

Proof: Let A be a α^{**}- closed set. Let A⊆ U ,where U is open. since U is open, U is α^{*}open. Hence Cl(A)⊆ U, since A is α^{**}-closed set. α Cl(A)⊆Cl(A) and hence A is a α g-closed set.

The following example support that a α g-closed set need not be α^{**}- closed set in general.

Example 3.11: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then A={c} is a α g- closed but not α^{**}- closed in (X, τ).

Proposition 3.12:Every α^{**}- closed set is a gsp-closed set.

Proof follows from the definitions.

The converse of the above proposition need not true in general as seen in the following example.

Example 3.13: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then A={a,b} is a gsp- closed but not α^{**} -closed in (X, τ).

Proposition 3.14: Every α^{**} closed set is a ω g-closed set.

Proof: Let A be a α^{**}- closed set.Let A⊆ U and U be open.Since U is open, U is α^{*}open. HenceCl(A)⊆ U, since A is α^{**} -closed set Cl(int(A))⊆Cl(A)⊆U & hence cl(int(A)) ⊆U, whenever A⊆U & U is open.∴ A is a ω g-closed set.

The converse of the above proposition need not true in general as seen in the following example.

Example 3.15: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then A={c} is a ω g- closed but not α^{**}closed in (X, τ).

Proposition 3.16: Every g^{*}-closed set is a α^{**} closed set.

proof follows from the definitions.

The converse of the above need not be true.

Example 3.17: Let X={a,b,c}, τ ={ Φ ,X,{a}}.Then A={b} is a α^{**}closed but not g^*-closed in (X, τ).

Remark 3.18: α^{**}- closedness is independent of g α –closedness.

Example 3.19: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then A={c} is g α - closed but not α^{**}closed in (X, τ).

Example 3.20: Let X={a,b,c} , τ ={ Φ ,X,{b},{b,c}}.Then A={a,b} is α^{**}-closed set but not g α -closed in (X, τ).

Hence α^{**}- closedness is independent of g α –closedness.

Remark 3.21: ω closedness is independent of α^{**} closedness.

Example 3.22: Let X={a,b,c}, τ = { Φ ,X,{a},{b,c}}.Then A={b} is a ω -closed set but not α^{**} closed in (X, τ).

Example 3.23: Let X ={a,b,c} , τ ={ Φ ,X,{a}}.Then B={b} is α^{**}-closed but not ω-closed in (X, τ).

$\therefore$ ω closedness is independent of α^{**} closedness.

Remark 3.24: α closedness is independent of α^{**} closedness.

Example 3.25: Let X={a,b,c}, τ ={ Φ ,X,{a}}.Then A={a,b} is α^{**} closed but not α -closed in(X, τ).

Example 3.26: Let X={a,b,c} , τ ={ Φ ,X,{a},{a,c}}.Then B={c} is α -closed but not α^{**}-closed in (X, τ).

$\therefore$ α closedness is independent of α^{**} closedness.

Remark 3.27: α^* closedness is independent of α^{**} closedness.

Example 3.28: Let X ={a,b,c} , τ ={ Φ ,X,{a}}.Then A={a,b} is α^{**} -closed but not α^*closed in (X, τ).

Example 3.29: Let X ={a,b,c}, τ ={ Φ ,X,{a},{b,c}}.Then B={b} is α^{*}-closed set but not α^{**}closed in (X, τ).

Hence α^{*} closedness is independent of α^{**} closedness.

Proposition 3.30: Every $\overline{\psi}$ -closed set is α^{*} closed.

Proof follows from the definitions.

The converse of the above proposition need not true in general as seen in the following example.

Example 3.31:Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then A={b} is α^{*}-closed but not $\overline{\psi}$-closed in (X, τ).**Proposition 3.32:**Every α^{**} -closed set is $\overline{\psi}^{*}$ -closed.

Proof follows from the definitions.

The converse of the above proposition need not true in general as seen in the following example.

Example 3.33: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then A={b} is a $\overline{\psi}^{*}$ - closed but not α^{**} closed in (X, τ).

Remark 3.34: $(g\alpha)^{*}$ closedness is independent of α^{**}closedness.

Example 3.35: Let X={a,b,c} , τ ={ Φ ,X,{a}}.Then A={a,b} is α^{**}- closed but not $(g\alpha)^{*}$-closed in (X, τ).

Example 3.36: Let X ={a,b,c} , τ ={ Φ ,X,{c},{a,c}}.Then B={a} is $(g\alpha)^{*}$-closed but not α^{**}- closed in (X, τ).

Hence $(g\alpha)^{*}$ closedness is independent of α^{**}closedness.

Proposition 3.37: If A is both α^{*}-open and α^{**}-closed set of (X, τ) then A is a closed set.

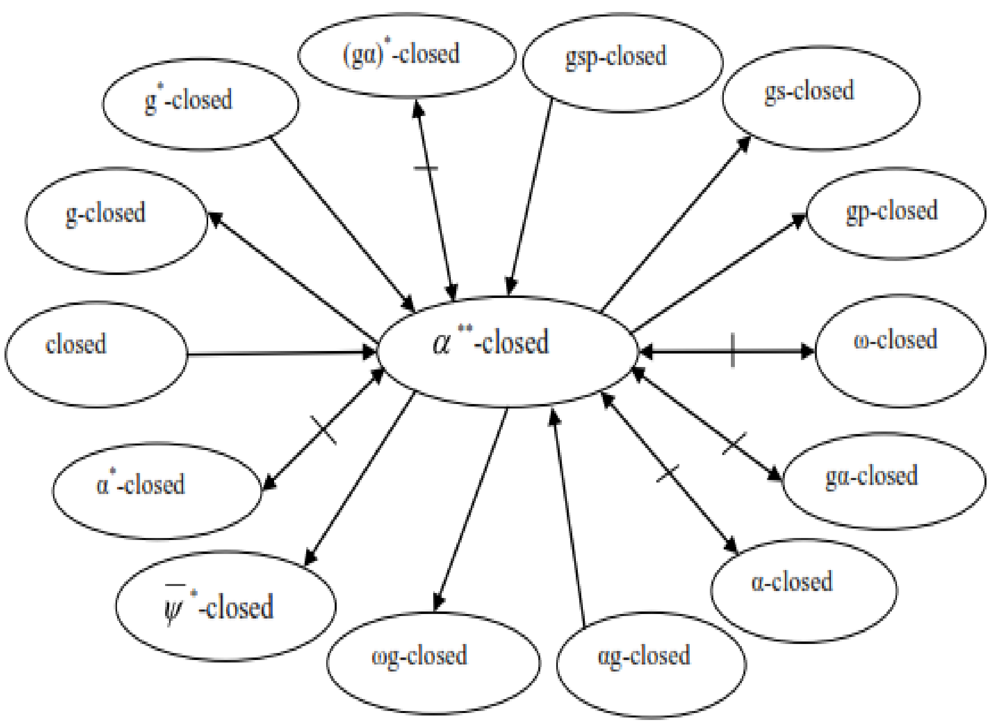
Proposition 3.38: A is α^{**}-closed set of (X, τ) if and only if Cl(A)\A does not contain any non-empty α^{*} -closed set.

Proof: Necessity: Let F be a α^{*}-closed set of (X, τ) such that F⊆Cl(A)\A. Then A⊆X\F.A is an α^{**}-closed set and X\F is α^{*}-open , such that A⊆X\F. ThenCl(A)⊆X\F ,since A is α^{**}-closed. F⊆X\Cl(A). Hence F⊆((X\Cl(A)) $\cap$ ((Cl(A)\A)= Φ .ThereforeF= Φ .

Sufficiency: Let A be a subset of (X, τ) such that Cl(A)\A does not contain any non-empty α^*-closed set. Let U be a α^*-open set of (X, τ) such that $A \subseteq U$. If $Cl(A) \nsubseteq U$, then $Cl(A) \cap U^c \neq \Phi$ and $Cl(A) \cap U^c$ is α^*-closed set. Therefore $\Phi \neq Cl(A) \cap U^c \subseteq Cl(A) \setminus A$. Therefore Cl(A)\A contains a non-empty α^*-closed set which is a contradiction. Therefore $Cl(A) \subseteq U$ and hence A is α^{**}-closed.

Proposition 3.39: If A is an α^{**}-closed set (X, τ) such that $A \subseteq B \subseteq Cl(A)$, then B is an α^{**}-closed set of (X, τ).

Remark 3.40: Thus we have the following diagram.



Where A $\longrightarrow$ B (res. A $\longleftrightarrow\!\!\!\!\!\!|\;\;\;$ B) represents A implies B but not conversely (resp. A and B are independent).

4. Applications of α^{**}-closed sets

In this section we introduce five new spaces namely ; $T_{\alpha^{**}}$, ${}_{\alpha g}T_{\alpha^{**}}$, ${}_{gs}T_{\alpha^{**}}$, ${}_{g}T_{\alpha^{**}}$ and ${}_{g^*}T_{\alpha^{**}}$.

Definition 4.1: A space (X, τ) is called a $T_{\alpha^{**}}$ space if every α^{**}-closed set is closed.

Theorem 4.2: Every $T_{1/2}$ space is a $T_{\alpha^{**}}$ space.

Proof follows from the definitions.

The converse of the above theorem need not true in general as seen in the following example.

Example 4.3: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then (X, τ) is a $T_{\alpha^{**}}$ space. A={a,b} is g-closed but not a closed set. Therefore(X, τ) is not a $T_{1/2}$ space.

Theorem 4.4: Every T_b space is a $T_{\alpha^{**}}$ space.

Proof: Let (X, τ) be a T_b space.Let A be a α^{**}-closed set.Then A is gs-closed.since (X, τ) is a T_b space ,A is closed .Hence the space (X, τ) is a $T_{\alpha^{**}}$ space.

The converse of the above theorem need not true in general as seen in the following example.

Example 4.5: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then (X, τ) is a $T_{\alpha^{**}}$ space.A={c} is gs-closed but not a closed set.Therefore(X, τ) is not a T_b space.

Theorem 4.6: A space which is both $T_{1/2}$ and T_d is $T_{\alpha^{**}}$ space**.**

Theorem 4.7: A space which is both ${}_{\alpha}T_d$ and $T_{1/2}$ is a $T_{\alpha^{**}}$ space.

Proof: Let A be a α^{**} -closed set.Then A is a α g-closed set .Since X is a ${}_{\alpha}T_d$ space, Ais g-closed.Since the space is a $T_{1/2}$ space ,A is closed.Hence (X, τ) is a $T_{\alpha^{**}}$ space.

Theorem 4.8: Every ${}_{\alpha}T_b$ space is a $T_{\alpha^{**}}$ space but not conversely.

Example 4.9: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then (X, τ) is a $T_{\alpha^{**}}$ space. A={c} is α g-closed set but not a closed set.Therefore(X, τ) is not a ${}_{\alpha}T_b$ space.

We introduce the following definition.

Definition 4.10: A space (X, τ) is called a ${}_{gs}T_{\alpha^{**}}$ space if every gs-closed set is a α^{**}-closed set.

Theorem 4.11: Every T_b space is a ${}_{gs}T_{\alpha^{**}}$ space but not conversely.

Example 4.12: Let X={a,b,c} , τ ={ Φ ,X,{a}}.Then (X, τ) is a ${}_{gs}T_{\alpha^{**}}$-space .A={b} is a gs-closed set but not a closed set. Therefore (X, τ) is not a T_b-space.

Theorem 4.13:A space which is both $T_{\alpha^{**}}$and ${}_{gs}T_{\alpha^{**}}$is a T_b- space.

Proof: Let A be a gs-closed set of (X,τ) .Then, since (X,τ) is a ${}_{gs}T_{\alpha^{**}}$-space ,A is α^{**} closed &Since (X,τ) is a $T_{\alpha^{**}}$-space,A is closed.Therefore (X,τ) is a T_b-space.

Theorem 4.14: Every ${}_{gs}T_{\alpha^{**}}$space is a T_d space**.**

The converse of the above need not be true.

Example 4.15: Let X={a,b,c} , $\tau=\{\Phi,X,\{a\},\{b,c\}\}$.Then (X,τ) is a T_d space. A={b} is gs closed set but not a α^{**}-closed set. Therefore (X,τ) is not a ${}_{gs}T_{\alpha^{**}}$space.

Remark 4.16:$T_{\alpha^{**}}$ness is independent from ${}_{gs}T_{\alpha^{**}}$ness.

Example 4.17: Let X={a,b,c} , $\tau=\{\Phi,X,\{a\}\}$.Then (X,τ) is a ${}_{gs}T_{\alpha^{**}}$-space .A={b} is α^{**}-closed but not closed.Hence (X,τ) is not a $T_{\alpha^{**}}$-space.

Example 4.18: : Let X={a,b,c} , $\tau=\{\Phi,X,\{a\},\{b,c\}\}$.Then (X,τ) is a $T_{\alpha^{**}}$-space . B={b} is gs-closed but not α^{**}-closed.Hence (X,τ) is not a ${}_{gs}T_{\alpha^{**}}$-space

$\therefore T\alpha^{**}$ness is independent from ${}_{gs}T_{\alpha^{**}}$ness.

We introduce the following definition.

Definition 4.19:A space (X,τ) is called a ${}_{\alpha g}T_{\alpha^{**}}$space if every α g-closed set is a α^{**}-closed set.

Theorem 4.20: Every ${}_{\alpha}T_b$ space is a ${}_{\alpha g}T_{\alpha^{**}}$space but not conversely.

Example 4.21:Let X={a,b,c} , $\tau=\{\Phi,X,\{a\}\}$.Then (X,τ) is ${}_{\alpha g}T_{\alpha^{**}}$space.A={b} is α g-closed but not a closed .Therefore (X,τ) is not a ${}_{\alpha}T_b$space.

Theorem 4.22:A space which is both $T_{\alpha^{**}}$and ${}_{\alpha g}T_{\alpha^{**}}$ is a ${}_{\alpha}T_b$space.

Theorem 4.23: Every${}_{\alpha g}T_{\alpha^{**}}$is a ${}_{\alpha}T_d$space but not conversely.

Example 4.24: Let X={a,b,c} , $\tau=\{\Phi,X,\{a\},\{b,c\}\}$.Then (X,τ) is a ${}_{\alpha}T_d$space. A={b} is α g closed but not α^{**}-closed .Hence (X,τ) is not a ${}_{\alpha g}T_{\alpha^{**}}$space.

Remark 4.25: $T_{\alpha^{**}}$ness is independent from $_{\alpha g}T_{\alpha^{**}}$ness.

Example 4.26: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then (X, τ) is a $T_{\alpha^{**}}$space. A ={c} is α g closed but not α^{**}-closed. Therefore (X, τ) is not a$_{\alpha g}T_{\alpha^{**}}$space.

Example 4.26: Let X={a,b,c} , τ ={ Φ ,X,{a}}.Then (X, τ) is a $_{\alpha g}T_{\alpha^{**}}$space. A={b} is α^{**}-closed but not closed .Hence (X, τ) is not a$T_{\alpha^{**}}$space.

$\therefore$ $T_{\alpha^{**}}$ness is independent from $_{\alpha g}T_{\alpha^{**}}$ness.

We now introduce the following definition.

Definition 4.28:A space (X, τ) is called a $_{g}T_{\alpha^{**}}$space if every g-closed set is a α^{**}-closed set.

Theorem 4.29: Every $T_{1/2}$ space is a $_{g}T_{\alpha^{**}}$space but not conversely.

Example 4.30: Let X={a,b,c} , τ ={ Φ ,X,{a}}.Then (X, τ) is $_{g}T_{\alpha^{**}}$space.A={b} is g-closed but not a closed set.Therefore (X, τ) is not a $T_{1/2}$space .

Theorem 4.31:A space which is both$T_{\alpha^{**}}$and $_{g}T_{\alpha^{**}}$is a $T_{1/2}$ space.

Theorem 4.32: Every $_{\alpha g}T_{\alpha^{**}}$space is a $_{g}T_{\alpha^{**}}$space but not conversely.

Example 4.33: Let X={a,b,c} , τ ={ Φ ,X,{b},{b,c}}.Then (X, τ) is a $_{g}T_{\alpha^{**}}$space.A ={c} is α g closed but not α^{**}-closed.Therefore (X, τ) is not a $_{\alpha g}T_{\alpha^{**}}$space.

Remark 4.34: $T_{\alpha^{**}}$ness is independent from $_{g}T_{\alpha^{**}}$ness. .

Example 4.35: Let X={a,b,c} , τ ={ Φ ,X,{a},{b,c}}.Then (X, τ) is a $T_{\alpha^{**}}$ space. A ={c} is g-closed but not α^{**}-closed. Therefore (X, τ) is not a$_{g}T_{\alpha^{**}}$space.

Example 4.36: Let X={a,b,c} , τ ={ Φ ,X,{a}}.Then (X, τ) is a$_{g}T_{\alpha^{**}}$space.A={b} is α^{**}-closed but not closed.Therefore (X, τ) is not a$T_{\alpha^{**}}$space.

Theorem 4.37: Every $_{gs}T_{\alpha^{**}}$space is $_{g}T_{\alpha^{**}}$space.

The converse of the above theorem need not true in general as seen in the following example.

Example 4.38: Let X ={a,b,c} , τ ={ Φ ,X,{b},{a,b}}.Then (X, τ) is $a_{g}T_{\alpha^{**}}$space .A={a} is a gs-closed set but not a α^{**} closed set. Therefore (X, τ) is not a $_{gs}T_{\alpha^{**}}$space .

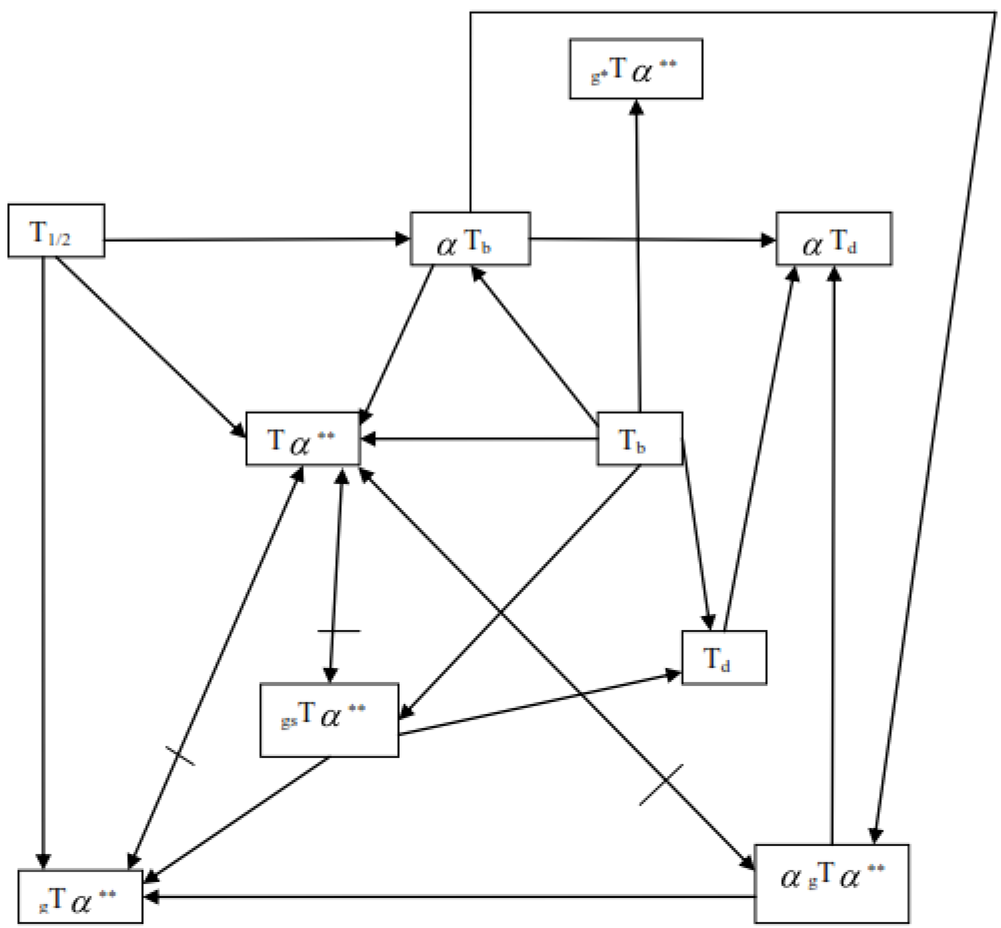
We now introduce the following definition.

Definition 4.39:A space (X, τ) is called a $_{g^*}T_{\alpha^{**}}$space if every α^{**} -closed set is g^*-closed.

Theorem 4.40: Every T_b space is a $_{g^*}T_{\alpha^{**}}$space but not conversely.

Example 4.41: Let X={a,b,c} , τ ={ Φ ,X,{a},{a,c}}.Then (X, τ) is $a_{g^*}T_{\alpha^{**}}$space .A={c} is a gs-closed set but not a closed set.Therefore (X, τ) is not a T_b-space.

Remark 4.42: Thus we have the following diagram.



where A $\longrightarrow$ B (resp. A $\longleftrightarrow$ B) represents A implies B but not conversely (resp.A and B are independent)

Reference:

[1].Andrijevic .D semi-preopen sets,mat.vesnik 38(1) (1986),24-32.

[2].Arya S.P and nour.T ,characterization of s-normal spaces, Indian J.pure .Appl.,Math.,21(8) (1990),717-719.

[3].Daffiny Swarna kumari.E, Veronica Vijayan,(g)*-closed sets in topological spaces, IJCA, Issue 3,volume 3(May-June 2013),ISSN:2250-1797.

[4].Devi. R, Balachandran. K and Maki .H, generalized -closed maps and -generalized closed maps,Indian J.Pure,Appl.Math.,29(1998),37-49.

[5]. Devi. R, Balachandran. K and Maki .H, semi-generalized closed maps and generalized closed maps, Mem .Fac. sci. kochi univ.ser.A.Math.,,14(1993) 41-54..

[6].Dontchev.J, on generalized semi-pre open sets, Mem. Fac.sci. kochi .univ. ser .A.Math,17(1995),35-48.

[7].Levine.N, generalized closed sets in topology, Rend circ. math.,palermo19(2)(1970),89-96.

[8].Levine. semi-open sets and semi continuity in topology spaces Amer.Math.Monthly,70(1963)36-41.

[9]. Maki.H, Devi.R and K. Balachandran Associated topologies of generalized -closed maps and - generalized closed sets ,Mem .Fac.sci.kochi.univ.ser.A.Math.,15(1994), 51-63 .

[10].Maki.H, Devi.R and K.Balachandran generalized -closed sets in topology, Bull. Fukuka univ. Ed part (111),42(1993),13-21.

[11].Maki.H,J.umehara and T.noiri , Every topological space is pre T1/2 ,Mem.fac. soi. Kochi, univ-ser. A, Math.,17(1996),33-42.

[12].Mashhour, I.A.Hasanein and S.N.el. Deep, -continuous and - open mapping. ,Acta Math.Hung.,41(3-4)(1983),213-218.

[13] Nagaveni, studies on generalization of homeomorphisms in topological spaces.ph.D thesis,Bharathiar university,Coimbatore,1999.

[14].Pauline mary Helen M,Veronica Vijayan,Ponnuthai Selvarani, g**-closed sets in topological spaces IJM A 3(5),(2012),1-15.

[15].Sundaram.P, & Sheik John .M(1995) Weakly closed sets and Weak continuous maps in topological spaces Proc.82nd Indian Sci.Cong.49.(50-58).

[16].Veerakumar. M.K.R.S. between closed sets and g-closed sets,Mem.Fac .Sci.kochi.univ.ser.A,Math.,17(1996),33-42.

[17].Veronica Vijayan, Priya.F, *closed sets in topological spaces IJCA Issue 3,volume 4(July-August 2013)ISSN-(2250-1797),49-60.

[18].Veronica Vijayan, K.Selvapriya, -closed, -closed in topological space, IJCA, Issue 3,volume (April-2013),ISSN:2250-1797.