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Delta convergence of grills

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ABSTRACT
In this paper, we explore different notions of sets namely α-open , semi-open , pre-open , b-open and β-open to define the concept of delta-convergence and delta-adherence of grills in a topological space. Further, we discuss their characterizations

Introduction

We assume basic knowledge of topology; open and closed sets, closure , interior for different family of sets namely α-open sets, semi-open sets, pre-open sets, b-open sets and β-open sets. In metric spaces, properties such as continuity, closure and compactness can be stated completely in terms of sequences. This breaks down in general topological spaces, where sequences can't even tell whether a set is closed. In 1922, Moore and Smith discovered a generalization of sequences, called nets which are ad- equate to describe those things. Despite their sheer dissimilarity nets are equivalent to filters in terms of results (which include Tychonoff 's theorem, purported to be one of the hardest in topology).

Choquet[8] introduced an attractive theory of Grills, a collection satisfies some condition in Topological space. The topology equipped with the grill collection is called Grill topology.

This topic has an excellent potential for application in other branches of mathematics like compactifications, Proximity spaces, different types of extension problems etc. This subject was continued to study by general topologists Roy and Mukherjee [18], [19] in recent years. It was probably the two articles of M.K. Singal and Asha Mathur [20],[21] that initiated the study of nearly Compact spaces in general topology.

The purpose of this paper is to define and discuss the concepts of δ − convergence and δ − adherence of grills in the different family sets of X.

Preliminaries

Definition 2.1 :[19]

A collection G of nonempty subsets of a set X is called a grill if
1. A ∈ G and A ⊆ B ⊆ X implies that B ⊆ G, and
2. A ∪ B ∈ G (A, B ⊆ X) implies that A ∈ G or B∈ G.

Definition 2.2 :[19]

A grill G on a set X is said to be a σ-grill if for any countable collection {A : n ∈ N } of subsets of X, A ∉ G whenever A ∉ G or each n ∈ N .

Definition 2.3 :[26]

A subset of a space is said to be regularly open, it is the interior of some closed set or equivalently, if it is the interior of its own closure. A set is said to be regularly closed if it is the closure of some open set or equivalently, if it is the closure of its own interior.

Definition 2.4 :[24]

Let (X, τ) be a space. Then the following hold.
(a) For any grill (resp. filter) G on a space X, sec G is a filter (resp. grill) on X.
(b) If F is a filter and G is a grill such that F ⊂ G, then there is an ultrafilter U on X such that F ⊂ U ⊂ G.

Definition 2.5 :[16]

A nonempty set A of a space (X, τ) is said to be μ-closed relative to X if for every cover $\{V_\alpha; \alpha \in \Lambda\}$ of A by μ-open sets , there exists a finite subset Λ_t of Λ such that $A \subset \cup\{c_\mu(V_\alpha); \alpha \in \Lambda_t\}$. A space X is called μ-closed if A = X.

Convergence and adherence of grills

Definition 3.1

A grill G on X is said to be δ-adheres at x in X if for each U ∈ τ containing x and each G ∈G, intcl (U) ∩ G ≠ ø.

Definition 3.2

A grill G on X is said to be δ-converges at x in X if for each U ∈ τ containing x, there exists G ∈ G such that G ⊂ intclU . Clearly a grill G converges to x ∈ X if and only if G contains the collection $\{\text{intcl } U_x \setminus U_x \in X\}$.

Note 3.2.1

Let (X, τ) be a space and P ={σ, π, b, β}. For μ ∈ P, A grill G on X is said to be δ_μ − adheres at x in X if for each U ∈ μ containing x and each G ∈ G, $int_\mu cl_\mu(U) \cap G \neq ø$ G is said to be δ_μ − converges to x ∈ X if for each U ∈ μ containing x, there exists $G \subset int_\mu cl_\mu(U)$. Clearly, a grill G is δ_μ − converges to x ∈ X if and only if G contains the collection $\{int_\mu cl_\mu(U) \setminus x \in A \in \mu\}$.

Definition 3.3

A filter F on a topological space (X, τ) is said to be δ_μ − adheres at x in X if for each U ∈ μ containing x and each F ∈ F , $int_\mu cl_\mu(U) \cap F \neq ø$, F is said to be δ_μ − converges to x ∈ X if for each U ∈ μ containing x, there exists $F \subset int_\mu cl_\mu(U)$.

Definition 3.4

Let G be a grill on the topological space (X, τ). Then $G(\delta_\mu, x) = \{A \subset X ; x \in c_{\delta\mu}(A)\}$.

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Definition 3.5

Let (X, τ, G) be a grill topological space, then secG (δ_μ, x) = {A ⊂ X ; A ∩ G ≠ ø for all G ∈ G (δ_μ, x)}.

Theorem 3.6

Let (X, τ) be a space with a grill G. If G, δ_μ − adheres at some point x ∈ X , then G is δ_μ − converge to x.

Proof

Suppose G, δ_μ − adheres at x ∈ X . Then for each μ-open set U containing x and each G ∈ G, $int_\mu cl_\mu$(U) ∩ G ≠ ø. ⇒ $int_\mu cl_\mu$(U) ∈ sec G for each μ-open set U containing x. Therefore X − $int_\mu cl_\mu$(U) ∉ G whenever x ∈ U ∈ μ. Since X ∈ G and G is a grill on X, $int_\mu cl_\mu$(U) ∈ G for each μ-open set containing x. Thus , G is δ_μ− convergent to x.

Theorem 3.7

Let G be a grill on a space (X, τ). Then the grill G, δ_μ − adheres at x ∈ X if and only if G ⊂ G (δ_μ, x).

Proof

If G, δ_μ − adheres at x ∈ X implies that $int_\mu cl_\mu$ ∩ G ≠ ø for all G ∈G and for every μ-open set U containing x. Therefore, x ∈ $c_{\delta\mu}$ (G) for all G ∈ G and so G ∈ G (δ_μ, x) for all G ∈G. ⇒ G ⊂ G (δ_μ, x). Conversely assume that G ⊂ G (δμ, x). Then for every G ∈ G ,G ∈ G (δ_μ, x) and so x ∈ $c_{\delta\mu}$ (G) ⇒ $int_\mu cl_\mu$(U) ∩ G ≠ ø for every U ∈ μ containing x. Hence G, δμ − adheres at the point x.

Theorem 3.8

Let G be a grill on a space (X, τ). Then G is δ − convergent to x ∈ X if and only if secG (δμ, x) ⊂ G.

Proof

Let G be a grill on X which δ_μ − converges to x ∈ X. Then for each μ-open set U containing x, there exists a G ∈ G such that G ⊂ $int_\mu cl_\mu$(U). Since G is a grill on X, $int_\mu cl_\mu$(U) ∈ G. Let A ∈ secG (δ_μ, x). Then A ∩ G ≠ ø for all G ∈ G (δ_μ, x) and so X \A ∉ G (δ_μ, x).⇒ x ∉ $c_{\delta\mu}$ (X − A) and so cl_μ(V) ∩ (X − A) = ø for some V ∈ μ containing x. ⇒ cl_μ(V) ⊂ A which implies that A ∈ G. Thus secG (δ_μ, x) ⊂ G. Conversely let us assume that G does not δ_μ − converge to x ∈ X. Then there exists a μ-open set U containing x such that $int_\mu cl_\mu$ ∉G and $int_\mu cl_\mu$(U) ∉ secG (δ_μ, x). Since $int_\mu cl_\mu$(U) ∉ secG (δ_μ, x), there exists G ∈ secG (δ_μ, x) , such that cl_μ(U) ∩ G = ø. Since G ∈ secG (δ_μ, x), x ∈ $c_{\delta\mu}$ (G) and so $int_\mu cl_\mu$ ∩ G ≠ ø for all μ-open set U containing x, a contradiction. Hence G, δ_μ − converges to x.

Definition 3.9

A nonempty set A of a space (X, τ) is said to be AS_μ-set relative to X if for every cover {V_α; α ∈ Λ} of A by μ-open sets of X, there exists a finite subfamily Λ_0 of Λ such that A ⊂ ∪{$int_\mu cl_\mu(V_\alpha)$; α ∈ Λ_0}.

Definition 3.10

(1)The set of all AS_μ spaces is a subcollection of the family of μ closed spaces discussed in [16].

(2)A space X is AS_μ space if A=X. If μ = τ then the family of all AS_τ – spaces coincides with the family of all nearly compact spaces.

(3)If μ = π then the family of spaces are called AS_p space.

(4)If μ = β then the family of spaces are called AS_β space.

(5)If μ = b then the family of spaces are called AS_b space.

(6)If μ = σ then the family of spaces are called AS_s space.

Theorem 3.11

Let (X, τ) be a space and μ ∈ P. Then the following are equivalent.

(a)X is AS_μ space.

(b) Every maximal filterbase δ_μ − converges to some point of X.

(c)Every filterbase δ_μ − adheres at some point of X.

(d) For every family {V_α; α ∈ Λ} of AS_μ subsets such that ∩{V_α; α ∈ Λ} = ø, there exists a finite subset Λ_0 of Λ such that ∩{$int_\mu(V_\alpha)$; α ∈ Λ_0} = ø .

Proof

(a)⇒(b). Let F be a maximal filter base on X. Suppose that F does not δ_μ − converge to any point of X. For each x ∈ X , there exists F_x ∈ F and μ- open set U_x containing x such that F_x ∩ $int_\mu cl_\mu(U_x)$ = ø. Now {U_x ; x ∈ X } is a μ-open cover for X. By (a), there exists a finite subset {x_1, x_2, ...x_n} of X such that X = ∪{$int_\mu cl_\mu$; 1 ⊆ i ⊆ n}. Since F is a filter base, there exists F ∈ F such that F ⊂ ∩F_{xi} .

Now, ∩F_{xi} = (∩F_{xi}) ∩ (∪$int_\mu cl_\mu(U_{xi})$) = ∪((∩F_{xi}) ∩ $int_\mu cl_\mu(U_{xi})$) = ø. Hence F = ø, a contradiction.

(b)⇒(c). Let F be a filter base on X. Then there exists a maximal filter base F' such that F ⊂ F'. By (b), F δ_μ − converges to some point x ∈ X .For every F ∈ F and every U∈μ containing x, there exists F' ∈ F' such that F' ⊂ $int_\mu cl_\mu$(U). Now F' ⊂ $int_\mu cl_\mu$(U) implies that F'∩ F⊂ $int_\mu cl_\mu$(U) ∩ F. Since F' is a filterbase, F ∩ F' ≠ ø and so F ∩ $int_\mu cl_\mu$(U) ≠ ø. Hence F , δ_μ − adheres at x.

(c)⇒(d). Let {V_α ; α ∈ Λ} be a family of AS_μ- subsets of X such that ∩{V_α ; α ∈ Λ}= ø. Let I be a family of all finite subsets of Λ. Assume that A_I = ∩{$int_\mu(V_\alpha)$; α ∈ I } ≠ ø for every I ∈ I. Then the family F ={A_I ; I ∈ I } is a filter base on X. By, hypothesis, F ,δ_μ−adheres at some point x ∈ X . Since {X − V_α ; α ∈ Λ} is a μ-open cover of X, x ∈ X − V_β for some β ∈ Λ. Since $int_\mu cl_\mu$(X − V_β) ∩ $int_\mu(V_\beta)$ = ø, we have a contradiction to the fact that F , δ_μ − adheres at x ∈ X . Thus ∩{$int_\mu(V_\alpha)$; α ∈ I } = ø for some I ∈ I.

(d)⇒(a). Let {V_α; α ∈ λ} be a cover of X by μ-open sets of X. Then {X − V_α; α ∈ Λ} is a family of μ-closed subsets of X such that ∩{X − V_α; α ∈ Λ} = ø. By (d), there exists a finite subfamily Λ_0 of Λ such that ∩{int_μ(X − $V_{\alpha0}$)} = ø.

Hence X − ∩{int_μ(X − V_α); α ∈ Λ_0} = X which implies that ∪{$int_\mu cl_\mu(V_\alpha)$; α ∈ Λ} = X. Hence X is a AS_μ-space.

Theorem 3.12

A space (X, τ) is a AS_μ-space if and only if every grill on X δ_μ − converges in X.

Proof

Let G be a grill on a AS_μ-space X. Then by the lemma 1.1, secG is a filter on X. Let B ∈ secG. Then B ∩ G ≠ ø for every G ∈ G, X − B ∉ G. Hence B ∈ G, since G is a grill. Thus secG ⊂ G. By lemma 1.1 , there is an ultra filter U on X such that secG ⊂ U . Since X is AS_μ-space, by theorem 2.11, U δ_μ − converges to some point x ∈ X. Then for each μ-open set U containing x, there exists some G ∈ U such that G ⊂ $int_\mu cl_\mu$.Since $int_\mu cl_\mu$ (U) ∈ U , $int_\mu cl_\mu$(U) ∈ G for every U ∈ μ containing X. Hence G is δ_μ − adheres to x. Conversely, let U be an ultrafilter on X. Since every ultrafilter is a grill, U δ_μ − converges to some point of X.

Corollary 3.13

A space (X, τ) is nearly compact if and only if every grill G on X ,δ − converges in X.

Theorem 3.14

A subset A of a space (X, τ) is AS_μ-subset relative to X if and only if every grill on X with a ∈ G, δ_μ − converges to a point in A.

Proof

Let A be AS_μ-subset relative to X and G be a grill on X such that $A \in G$ and G does not δ_μ − converge to any point of A. Then, for each $x \in A$, there exists $U_x \in \mu$ containing x such that $int_\mu cl_\mu(U_x) \notin G$. Now $\{U_x; x \in A\}$ is a cover of A by μ-open sets of X. Since A is AS_μ subset relative to X, there exists a finite subset B of A such that $A \subset \cup\{int_\mu cl_\mu(U_x); x \in B\}$. Since G is a grill, $\cup\{int_\mu cl_\mu(U_x); x \in B\} \notin G$. Hence $A \notin G$, a contradiction. Hence G δ_μ − converges to some point in A. Conversely let $U = \{U_\alpha; \alpha \in \Lambda\}$ be a cover of A by μ-open sets of X. If A is not AS_μ- subset relative to X, then for every finite subset λ_0 of Λ, $A - \cup\{int_\mu cl_\mu(U_\alpha); \alpha \in \Lambda_0\} \neq ø$. Let $F = \{A - \cup int_\mu cl_\mu(U_\alpha); \alpha \in \Lambda_0, \Lambda_0 \subset \Lambda$ is finite$\}$. Then F is a filterbase on X. The family F can be extended to an ultrafilter M on X. Then M is a grill on X. Since for every $F \in F$, $F \subset A$, we have $A \in M$. But U is a cover of X, then for all $x \in A$, there exists $\beta \in \Lambda$ such that $x \in U_\beta$. For any $G \in M$, $G \cap (A - int_\mu cl_\mu(U_\beta)) \neq ø$. Hence $G \not\subset int_\mu cl_\mu(U_\beta)$ for all $G \in M$ and so M does not δ_μ − converge to any point A, a contradiction. Thus if every grill on X with $a \in G$, δ_μ − converges to a point in A, then the subset A of a space (X, τ) is AS_μ-subset relative to X. Hence the proof.

Theorem 3.15

Let (X, τ) be space such that every grill G on X with the property $\cap\{c_{\delta\mu}(G_i); 1 \subseteq i \subseteq n\} \neq ø$ for every finite subfamily $\{G_1, G_2, ...G_n\}$ of G, δ_μ − adheres in X, Then X is a AS_μ-space.

Proof

Let U be any ultrafilter on X. Then U is a grill on X. Also, for each finite subcollection $\{U_1, U_2, ...U_n\}$ of U , $\cap\{U_i; 1 \subseteq i \subseteq n\} \neq ø$. Since $\cap\{U_i; 1 \subseteq i \subseteq n\} \subset \{c_{\delta\mu}(U_i); 1 \subseteq i \subseteq n\}$, $\cap\{c_{\delta\mu}(U_i); 1 \subseteq i \subseteq n\} \neq$ X. Therefore X is AS_μ-space. ø. Hence by hypothesis, U δ_μ −adheres.

Definition 3.16

A grill G on the topological space (X, τ) is said to be δ_μ − linked if for any two members $A, B \in G$, $c_{\delta\mu}(A) \cap c_{\delta\mu}(B) \neq ø$.

Definition 3.17

A grill G on the topological space (X, τ) is said to be δ_μ − conjoint if every finite subfamily $\{A_1, A_2, ...A_n\}$ of G, $int_\mu(\cap\{c_{\delta\mu}(A_i); 1 \subseteq i \subseteq n\}) \neq ø$.

Remark 3.18

(1)Every δ_μ − conjoint grill is δ_μ − linked.

(2)If $\mu = \pi$, we have p(δ) − linked grill and p(δ) − conjoint grill.

Theorem 3.19

Let (X, τ) be a AS_μ-space. Then every δ_μ −conjoint grill δ_μ −adheres in X.

Proof

Let G be a δ_μ − conjoint grill on a AS_μ-space X. Since $c_{\delta\mu}(A)$ is AS_μ- space for every $A \subset X$, $\{c_{\delta\mu}(A); A \in G\}$ is a collection of AS_μ-sets in X. But G is δ_μ − conjoint, for any finite sub family$\{A_1, A_2, ...A_n\}$ of G, $int_\mu(\cap\{c_{\delta\mu}(A_i); 1 \subseteq i \subseteq n\}) \neq ø$ and so $\cap\{int_\mu(c_{\delta\mu}(A_i)); 1 \subseteq i \subseteq n\}) \neq ø$. Hence $\cap\{c_{\delta\mu}(A); A \in G\} \neq ø$ and so there exists $x \in X$ such that $x \in c_{\delta\mu}(A)$ for every $A \in G$ which implies that $A \in G(\delta_\mu, x)$ for all $A \in G$ which implies that $G \subset G(\delta_\mu, x)$. Therefore, G δ_μ − adheres at x in X. Hence the proof.

Theorem 3.20

Let (X, τ) be a AS_μ-space where $\mu \in \{\sigma, b, \beta\}$.Then every grill G on X, with the property that $\cap\{c_{\delta\mu}(Gi); 1 \subseteq i \subseteq n\} \neq ø$ for every finite subfamily $\{G_1, G_2, ..., G_n\}$ of G, δ_μ − adheres in X.

Proof

Let X be a AS_μ-space. $G = \{G_\alpha; \alpha \in \Lambda\}$ be a grill on X with the property $\cap\{c_{\delta\mu}(G_\alpha); \alpha \in \Lambda 0\}$ /= ø for every finite subset Λ_0 of Λ. Consider the family $F = \{\cap\{c_{\delta\mu}(G_\alpha); \alpha \in \Lambda_0, \Lambda_0 \subset \Lambda\}\}$. Then F is a filtrbase on X. Since X is AS_μ-space, F, δ_μ − adheres at some point $x \in X$ implies that $x \in c_{\delta\mu}(c_{\delta\mu}(G))$ for every $G \in G$. Then $x \in c_{\delta\mu}(G)$ for every $G \in G$. Hence $G \subset G(\delta_\mu, x)$ and hence the proof.

Corollary 3.21

Let (X, τ) be a space where $\mu \in \{\sigma, b, \beta\}$. Then the following are equivalent.

(a) Every grill G on X, with the property that $\cap\{c_{\delta\mu}(G_i); 1 \subseteq i \subseteq n\} \neq ø$ for every finite subfamily $\{G_1, G_2, ..., G_n\}$ of G, δ_μ − adheres in X.

(b) X is AS_μ-space.

Proof

Using the theorems 2.20 and 2.15, we can prove this theorem.

Definitions 3.22

1. A space X is μN C compact where $\mu \in \{\tau, \alpha, \sigma, \pi, b, \beta\}$ if every cover U of X by μ-open sets of X has finite sub-collection such that the interiors of closures of whose members cover the space X.

2. A grill G on X is said to be μD − converge to a point $x \in X$ if $int_\mu cl_\mu(\mu(x)) \subset G$ where μ(x) denote the family of all μ-open sets containing the point x.

3. A space X is δ_μ − regular if for every grill on X which δ_μ − converges must μD − converge.

Theorem 3.23

A space (X, τ) is μ-nearly compact if and only if every grill μD − converges.

Proof

Let G be a grill on a μ nearly compact space X such that G does not μD − converge to any point $x \in X$. Then for each $x \in X$, there exists a μ-open set U_x containing x with $U_x \notin G$. Since $\{U_x; x \in X\}$ is a cover of the μ nearly compact X by μ-open sets, there exist finitely many points $\{x_1, x_2, ..., x_n\}$ in X such that $X = \cup\{U_{xi}; 1 \subseteq i \subseteq n\}$. Since $X \in G$, there exists $U_{xi} \in G$ for $1 \subseteq i \subseteq n$ a contradiction.

Conversely, let every grill on X μD − converge. Suppose X is not μ nearly compact. Then there exists a cover U of X by μ-open sets of X having no subcover. Then $F = \{X - \cup U_0; U_0$ is a finite subcollection of U$\}$ is a filter base on X. Then F is contained in an ultrafilter G and so G is a grill on X. By hypothesis, G ,μD − converges to to some point $x \in X$. Then for some $U \in U$, $x \in U$ and hence $U \in G$. But $X - U \in F \subset G$. Hence U and X − U both belongs to G, which is an ultrafilter, a contradiction. Therefore if every grill μD − converges then the space is μ-nearly compact.

Theorem 3.24

A μ-nearly compact space X is AS_μ-space. The converse holds if X is δ_μ − regular.

Proof

Suppose G is a grill on a AS_μ-space X. Then G δ_μ − converges in X, by theorem 2.12. Since X is δ_μ − regular, G μD − converges. By theorem 2.24, X is μ-nearly compact.

Theorem 3.25

Every μ − regular space is δ_μ − regular.

Proof

Let G be a grill on a μ − regular space X. Suppose δ_μ − converges to a point $x \in X$. For each $U \in \mu$ containing x, there exists a $V \in \mu$ containing x such that $int_\mu cl_\mu(V) \subset U$. By hypothesis, $int_\mu cl_\mu$ U ∈ G and so U ∈G. Hence G ,μD − converges to x. Thus X is δ_μ − regular.

Remark 3.26

For a topological space X the following are equivalent.

(1) X is μ-nearly compact.

(2) X is AS_μ-space.

(3) Every family of δ_μ-closure of sets having finite intersection property in grill δ_μ − adheres in X.

(4) Every filter (filter-base) of μ-open sets has δ − adherent point.

(5) Every ultrafilter(ultrafilter-base) of μ-open sets is δ − convergent.

(6) Every grill of μ-open sets in the topological space X is δ − adherent in X.

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References

[1] Abd EI-Aziz Abo-Khadra, On generalized forms of compactness, Masters The- sis, Faculty of Science, Tanta University, Egypt, 1989.

[2] M.E. Abd Ei-Monsef,S.N. Ei-Deep,R.A. Mahmoud, β-open sets and β- continuous mappings, Bull. Fac. Sci. Assiut Univ., 12(1983), no.1, 77-90.

[3] D. Andrijevic, Semi-preopen sets, Mat. Vesn., 38(1986), 24-32.

[4] D.Andrijevic, On b-open sets, Mat. Vesn., 48(1996), 59-64.

[5] Asha Mathur, Mamta Deb, A note on almost continuous mappings, Math. Student, 40 (1972), 173-184.

[6] C.K. Basu, M.K. Ghosh, β-closed spaces and βθ-subclosed graphs, Eur. J. Pure Appl. Math., 1(2008), No. 3, 40-50.

[7] N. Bourbaki, General Topology.

[8] G. Choquet, Sur les notions de Filtre et grille, Computes Rendus Acad. Aci. 224(1947), 171-173.

[9] J. Dugundji, Topology, Ally and Bacon, Boston, 1996.

[10] G.Di Maiko, T.Noiri, On s-closed spaces, Indian J. Pure Appl. Math., 18(1987), No.3,226-233.

[11] N. Levine, Semi-open sets and semi-continuity in topological spaces, Amer. Math. Monthly, 70(1963), 36-41.

[12] T.Noiri, Weak and strong forms of β-irresolute functions, Acta Math. Hung., 99(2003), No. 4, 315-328.

[13] E. Hatir, S. Jafari, On some new classes of sets and a new decomposition of continuity via grills, J. Adv. Math. Stud., 3(2010), No. 1, 33-40.

[14] J. H. Park, Strongly θ-b-continuous functions, Acta Math. Hung., 110(2006), No. 4, 347-359.

[15] J. Porter, J. Thomas, On H-closed and minimal Hausdorff spaces, Trans.Amer. Math. Soc., 138(1961), 159-170.

[16] V. Renukadevi, On the convergence and adherence of grills, J. Adv. Math.Stud.

[17] B. Roy, M.N. Mukherjee, On a type of Compactness via grills, Math. Vesnik 59(2007), 113-120.

[18] B. Roy, M.N. Mukherjee, P-closed topological spaces in terms of grills, Hacct. J. Math. Stat., 35(2006), No. 2, 147-154. .

[19] B. Roy, M.N. Mukherjee, P.Sinha, Concerning p-closed topological spaces, Revista De La Academia Canaria De Ciencias, XIV(2002), No. 1-2, 9-23.

[20] M.K. Singal, Asha Mathur, On nearly compact spaces, Boll. Un. Mat. Ital., (4), 6(1969), 89-99.

[21] M.K. Singal, Asha Mathur, On nearly compact spaces-II, Boll. Un. Mat. Ital., (4), 9(1974), 670-678.

[22] A.H. Stone, Hereditarily compact spaces, Amer. J. Math., 32(1960), 900-915.

[23] G.C. Strecker, Co-topologies and generalized compactness conditions, Ph.D. dissertation, Tulane University, 1966.

[24] W.J. Thron, Proximity structure and grills, Math. Ann., 206(1973), 35-62.

[25] N.V. Velicko, H-closed spaces, Mat.Sb., 70(112)(1966), 98-112.

[26] C. Wayne Patty, Foundations of Topology, Jones and Bartlett India Pvt.Ltd, NewDelhi, 2nd Edition(2010).