ISSN 2347-1921

On mα- Separation Axiom In Biminimal Space

Hussein K. Kadhim
University of Thi-Qar (in Iraq)
College of Education for pure sciences
Department of Mathematics
kadhimhussein82@yahoo.com

ABSTRACT

This paper deals with the extension and development of some of the concepts of the separation axiom in topological space into biminimal spaces. In Addition, to give new results and theorems, supported by illustrative examples.

KEYWORDS: Biminimal space; Mα-M_0 space; Mα-M_1 space; Mα-M_2 space; Mα-M_3 space; Mα-M_4 space.

Council for Innovative Research
Peer Review Research Publishing System
Journal: JOURNAL OF ADVANCES IN MATHEMATICS
Vol .10, No.5
www.cirjam.com , editorjam@gmail.com

ISSN 2347-1921

INTRODUCTION

Minimal spaces have been the subject of many research papers recently; see [1], [2], [3], [4], [5], [7] and [8]. Maki, H., Umehara J. and Noiri T. introduced the notions of minimal structure and minimal spaces in 1950, [9]. While the notion of biminimal space was introduced by Boonpok, C. [5] in 2010, which A set equipped with two minimal spaces is called a biminimal space, denoted by (X, M,N), where (X,M),(X, N) are two minimal spaces defined on X .

In 2013, Hashoosh and Farawi gave definition of mα-open in biminimal space. A subset A of X is said to be (mα-open set in biminimal space) if A ⊆ M-int (N - cl (M– int (A))) [6] .

In this paper we introduce new definitions of mα-M_0 space, mα-M_1 space and mα-M_2 space, and give some theorems and results, for them in biminimal space .In addition to the definitions of mα-regular space and mα-normal space are introduced and studied . Moreover, We got a series of theorems and important results as well as the basic concepts and the relationships of it .

The aim of this paper is to continue the discussion new classes of separation axioms in biminimal spaces.

1. PRELIMINARIES

1.1. Definition [9]

Let X be a nonempty set. A family M ⊆ P(X) is said to be minimal structure on X if Ø , X ∊ M . In this case (X, M) is called an minimal space.

A set A ∊ P(X) is said to be an m-open if A∊ M, B∊ P(X) is an m-closed set if B^c ∊ M. We set

m-Int(A) = ⋃{ U:U⊆ A,U∈M}

m-Cl(A)=⋂{F:A⊆F, F^c ∈M}.

1.2. Definition

i) Let (X,M) be an m-space then we say that (X,M) has the property $\mathcal{U}$ if the arbitrary union of m-open sets is an m-open set [10] .

ii) Let (X , M) be an m-space then we say that (X , M) has the property $\mathcal{J}$ if the any finite intersection of an m-open sets is an m-open [1].

1.3. Definition [5]

Let (X,M) , (X,N) are two minimal spaces defined on X, then the triple (X,M ,N) is called a biminimal space .

1.4. Definition [7].

Let A be a subset of X , then A is said to be mα-open set in biminimal space iff A ⊆ M-int (N - cl (M– int (A))). The family of all mα-open set of X is denoted by mα.(X).

1.5. Example:

Let X = { a, b, c } , M= { X , Ø , {a} , {b} } and N = { X , Ø ,{a},{c}}

(X, M) , (X, N) are two minimal spaces on X , then (X,M,N) is a biminimal space .

mα.(X) = { X , Ø , {a} , {b} {a, b}} .

Assume Y = {a}, then M-int ({a}) = {a} and N -cl (M-int {a}) = {b, a} hence M-int (N -cl (M-int {a})) =M-int({a, b}) = {a, b} .Thus, {a} ⊆ M-int (N -cl (M-int {a})). Therefore {a} is mα-open set in (X,M,N) , and in general in any biminimal space X, both X and Ø are clearly mα-open sets , so are the other cases {b} , {a, b} .

1.6. Remarks [7]

Let (X, M, N) be a biminimal space.

(1) A subset Y of X is called mα-closed set of X if the complement of Y is mα-open set of X.

(2) Every M-open set is mα-open set .

(3) mα-cl {x} ⊆ mα-cl (mα-cl {x}).

2. Mα-M_0 SPACE, Mα-M_1 SPACE AND Mα-M_2 SPACE IN BIMINIMAL SPACE

In this section, we introduce new definitions of mα-M_0 space, mα-M_1 space and mα-M_2 space, in addition to we recall some the results and relations between them with illustrated examples.

2.1. Definition

Let (X, M, N) be a biminimal space , then (X, M, N) is called mα-M_0 space iff for each pair of points x, y of X , such that x ≠ y , there exists mα-open set G containing x but not containing y or mα-open set H containing y but not containing x .

2.2. Example

Let X = { a, b, c } , M= { X , Ø , {a} , {b} } and N = { X , Ø ,{a},{c}}

(X, M) and (X, N) are two minimal spaces on X, then (X, M, N) is a biminimal space and mα.(X) = {X, Ø, {a} , {b} {a, b} } .

We note for every α and β in X such that α ≠ β, there exists mα-open {α} contains α but not containing β, therefore then (X, M, N) is mα-M_0 space.

2.3. Proposition

Let (X, M, N) be a biminimal space, if (X, M) is M_0 space, then (X, M, N) is mα-M_0 space .

Proof:

Let x , y ∈ X such that x ≠ y .Since (X, M) is M_0-space ,there exists M-open set A in X such that x ∈ A and y ∉ A .

Since every M-open set is mα-open set by (1.6) Remarks, so A is mα-open set such that x ∈ A and y∉A. Therefore (X, M, N) is mα-M_0 space .But the opposite of this proposition is not true (see 2.4. example below).

2.4. Example

Let X = { a, b, c } , M= { X , Ø , {a} , {b, c} } and N = { X , Ø ,{a }}.Then, (X, M) is not M_0-space. Since, mα.(X) ={ X , Ø ,{a},{b},{c},{a, b},{b, c},{a, c}}, so (X, M, N) is mα-M_0 space.

2.5. Theorem

Let (X, M, N) be biminimal space with property $\mathcal{J}$, then (X,M,N) is M_0 space iff for each distinct point x , y of X , mα-cl {x} ≠ mα-cl {y} .

Proof :

Let x, y ∈X, such that x ≠ y and let mα-cl {x} ≠ mα-cl {y}.Then there exists at the least one point w in X such that w ∈ mα-cl {x} , w ∉ mα-cl {y} .Suppose that x ∈ mα-cl {y} , so {x} ⊆ mα-cl {y}.Then mα-cl {x} ⊆ mα-cl (mα-cl {y}), by (1.6) Remarks.

But mα-cl(mα-cl {y}) = mα-cl {y} , then w ∈ mα-cl {y} and this is a contradiction .

So x ∉ mα-cl {y}, then x ∈ X-(mα-cl {y}). Since mα-cl {y} is mα-closed set, so X-(mα-cl {y}) is mα-open set.

Therefore, X-(mα-cl {y}) is mα-open set containing x but not y. Thus (X, M, N) is mα-M_0 space .Conversely, since (X, M, N) is mα-M_0 space , then for each two distinct point x , y∈X , there exists a mα-open set G such that x∈G , y∉G . X-G is mα-closed set which does not contain x , but contains y .By definition (2.1), mα-cl{y} is the intersection of all mα-closed set containing {y}.Thus mα-cl{y}⊆ X-G , then x∉X-G . This implies that x∉mα-cl {y}, so we have x∈ mα-cl {x}, x∉mα-cl {y}.

Therefore mα-cl{x} ≠ mα-cl {y}.

2.6. Theorem

The mα-M_0 space has the hereditary property, if mα-M_0 space has the property $\mathcal{J}$.

Proof :

Let Y be a minimal subspace of mα-M_0 space X , to prove Y is mα-M_0 space , let z_1 ≠ z_2 ∈ Y , since Y ⊆ X .

Then z_1 ≠ z_2 ∈ X and X is mα-M_0 space. There exists mα-open set G in X, such that z_1∈G and z_2∉G, so G ∩ Y is mα-open set in Y, and z_1∈ G ∩ Y and z_2 ∉ G ∩ Y.

Thus, Y is a mα-M_0 space.

2.7. Definition

A biminimal space (X, M, N) is called mα-M_1 space iff for each pair of distinct points x, y of X there exists two mα-open sets U, V such that x∈U, y∉U and y∈V, x∉V.

2.8. Theorem

If (X, M) is M_1 space, then (X, M, N) is mα-M_1 space.

Proof:

Let a, b∈X, a ≠ b. Since (X, M) is M_1 space, then there exists two M-open sets A and B in X such that a∈A, but b∉A, and b∈B, but a∉B. Since every M-open set is mα-open set by (1.6) Remarks , then A , B are mα-open sets , such that a∈ A , but b∉ A ; and b∈ B , but a∉B .Therefore (X,M,N) is mα-M_1 space .

2.9. Remark

The converse of the above proposition is not true , that is if (X, M, N) is mα-M_1 space , then it is not true that (X,M) is M_1 space by the previews example.

2.10. Theorem

The mα-M_1 space has the hereditary property, such that mα-M_1 space has the property $\mathcal{J}$.

Proof:

Let (X, M, N) be a mα-M_1 space and let (Y, M_Y, N_Y) be a minimal sub space of (X, M, N) ,and assume $y_1 \neq y_2 \in Y$ and since Y⊆ X , then $y_1 \neq y_2 \in X$.

Since X is mα-M_1 space, there exist two mα-open sets U, V in X, such that $y_1 \in U$, but $y_2 \notin U$, and $y_1 \in V$, but $y_2 \notin V$. Then $U_1 = U \cap Y$, $V_1 = V \cap Y$ are mα-open sets in Y and we have $y_1 \in U_1$, but $y_2 \notin U_1$; and $y_1 \notin V_1$, but $y_2 \in V_1$. Therefore (Y, M_y, N_y) is mα-M_1 space.

2.11. Theorem

A biminimal space (X, M, N) is a mα-M_1 space iff every single subset {x} of X is mα-closed.

Proof :

Suppose X is mα-M_1 space, and x be any point of X.

Let $y \in \{x\}^c$, then x ≠ y and so there exists mα-open set U containing y but not x , and mα-open set V containing x but not containing y, $y \in U \subseteq \{x\}^c$. Therefore $\{x\}^c$ is mα-open set , then {x} is mα-closed set .Conversely, suppose x , y∈X, such that x ≠ y. Since {x} is mα-closed set , then $\{x\}^c$ is mα-open set containing y but not x Similarly , $\{y\}^c$ is mα-open set containing x but not containing y .Therefore (X,M,N) is mα-M_1 space .

2.12. Theorem

Let (X,M,N) be a biminimal space has the property $\mathcal{J}$,then (X,M,N) is mα-M_1 space iff mα-cl{a}is empty set for each a ∈ X

Proof:

Suppose (X, M, N) be a mα- M_1 space. Let mα-cl {a}≠ Ø , for some a∈X, then there is a point b , such that b∈mα-cl {a} , and b ≠ a . Since X is mα-M_1 space, then there exist mα-open set G such that a∉G, b ∈G. Thus G ∩ {a} = Ø .

Therefore b∉mα-cl {a} , which is contradiction. Thus mα-cl {a} is empty set.

On the other hand, Let mα-cl {a} is empty set , for each a∈X , and let x , y ∈ X , such that x ≠ y .Then x∉mα-cl {y} , and there exists mα-open set G such that x∈G and G ∩ {y}= Ø , Therefore G contains x but not containing y .Similarly, there exists mα-open set contains y but not containing x . Thus (X, M, N) is mα-M_1 space.

2.13. Definition

Let (X,M,N) be a biminimal space has the property $\mathcal{J}$,then (X,M,N) is called mα-M_2 space(mα-Hausdorff) iff for each pair of distinct points x , y of X there exists two mα-open sets G , H Such that x∈G , y ∈ H , G ∩ H = Ø .

2.14. Proposition

Let (X, M, N) be a biminimal space has the property $\mathcal{J}$. If (X, M) is M_2 space, then (X, M, N) is mα-M_2 space .

Proof :

Assume x, y ∈ X, such that x ≠ y. Since (X, M) is M_2 space, then there exist two M-open set U and V in X such that x∈U, y∈V and U ∩ V = Ø.

Since every M-open set is mα-open by (1.6) Remarks, then U, V are mα-open sets such that x∈ U , y∈V , U ∩ V = Ø . Hence (X, M, N) is mα-M_2 space .The opposite of this proposition is not correct by the following example .

2.15. Example

Let (X, M, N) be biminimal space has the property $\mathcal{J}$ such that

X ={a, b, c }, M = { X , Ø , {a} , {b},{a, c} and N = { X , Ø},(X, M) , (X, N) are two minimal spaces on X , then (X,M,N) is a biminimal space. Then

mα.o(X) = { X , Ø , {a} , {b} {a, b},{a, c},{b, c} } .

We note (X, M) is not M_2-space, while (X,M,N) is mα-M_2 space.

2.16. Remark

Every mα-M_2 space is a mα-M_1 space, but the opposite is not correct (see 2.17. example below).

2.17. Example

Let X ={a, b, c }, M = { X , Ø ,{b},{a, b},{b, c}} and N = { X , Ø,{a, b}},(X, M) , (X, N) are two minimal spaces on X , then (X,M,N) is a biminimal space such that, it has the property $\mathcal{J}$. Then mα.o(X) = { X , Ø ,{b},{a, b},{b, c},{a, c}}.So, (X,M,N) is a mα-M_1 space, but is not a mα-M_2 space .

2.18. Theorem

The mα-M_2 space has the hereditary property, such that mα-M_2 space has the property $\mathcal{J}$.

Proof :

Let (X, M, N) be a mα-Hansdorff, such that Ø ≠ Y ⊆ X , and x ≠ y ∈Y , then x ≠ y ∈ X and , since (X,M,N) is mα-Hansdorff , there exists two mα-open sets G , H such that x ∈ G , y ∈ H , G ∩ H = Ø .

So G ∩ Y , H ∩ Y , is mα-open set in Y ,and x∈G ∩ Y, y∈H ∩ Y , and (G ∩ Y) ∩ (H ∩ Y) = (G ∩ H) ∩ Y = Ø .Therefore (Y,M_Y,N_Y) is mα-M_2 space .

3. ON Mα-REGULAR SPACE AND Mα-NORMAL SPACE

In this section, we introduce new definitions of mα-M_3 space, mα-M_4 space, mα-regular and mα-normal space, as well as, we recall several the results and facts between them .

3.1. Definition

Let (X, M, N) be biminimal space has the property $\mathcal{J}$, then (X,M,N) is called mα-regular space iff for each mα-closed set F is in X , and each x ∉ F ; and there exist mα-open sets U , V such that x ∈ U , F⊆ V , U ∩ V = Ø .

3.2. Proposition

Let (X, M, N) be biminimal space has the property $\mathcal{J}$, then if (X, M) is regular space , then (X,M,N) is mα-regular .

Proof :

Let F be M-closed set in X , x∈X such that x ∉ F .Since (X, M) is regular space , then there exists G , H are M-open set in X such that x ∈ G , F ⊆ H , G ∩ H = Ø . Since every M-open set is mα-open set by ((1.6) Remarks), then G, H are mα-open sets , such that x∈G ,F⊆ H ,G∩H = Ø Hence (X, M, N) is mα -regular .

3.3. Remark

The converse of the above proposition is not true as shown in the following example.

3.4. Example

Let (X, M, N) be a biminimal space , such that :

X = {a, b, c},

M = { X , Ø , {a} , {b}, {c}, {a, c} ,{a, b}} ,

N = { X,Ø ,{c} } .

(X, M), (X, N) are two m-spaces on X .

Then mα-o(X) = { X , Ø , {a} , {b}, {c} , {b, c} , {a, c} ,{a, b} } .

Take K = {b, c}, a ∉ K, then there exists {a}, {b, c}

mα-open sets such that a∈{a} , {b, c} ⊆ {b, c} ,

and {a} ∩ {b, c} = Ø .And similarly the other cases .Hence (X, M, N) is mα-regular space, but (X, M) is not m-regular space.

3.5. Theorem

Let (X, M, N) be biminimal space has the property $\mathcal{J}$, then (X, M, N) is mα-regular iff for each mα-open set U and x∈U , there exists mα-open set V such that x∈V, mα -cl (V) ⊆ U .

Proof :

Let (X, M, N) be mα-regular space . Let x∈ U where U is mα-open. Let H = U^c, then H is mα-closed , x ∉ H .Hence there exists mα-open sets K and M such that : x∈ M , H ⊆ K , M ∩ K = Ø .

Then M ⊆ K^c , mα-cl (M) ⊆ mα-cl(K^c) = K^c ………….(1)

H ⊆ K, then K^c ⊆ H^c = U , then K^c ⊆ U ………….(2)

From (1), (2) we have , x∈M , mα-cl (M) ⊆ U .

Conversely :

Let H be mα-closed set and $x \notin H$. Let $U = H^c$, then U is mα-open and $x \in U$. By hypothesis , there exists mα-open set M such that $x \in M$, mα-cl $(M) \subseteq U$, $H \subseteq (m\alpha\text{-cl}(M))^c$ .Since $x \in M$, $M \cap (m\alpha\text{-cl}(M))^c = \emptyset$ .Hence (X,M,N) is mα-regular .

3.6. Theorem

The mα-regular space has the hereditary property, such that mα-regular space has the property $\mathcal{J}$.

Proof :

Assume (X, M, N) is mα-regular space, let (Y, M_y, N_y) be a subspace of X. To prove (Y, M_y, N_y) is mα-regular ,Let $q \in Y$ and F be mα-closed set in Y , such that $q \notin F$. Then $m\alpha\text{-cl}_Y(F) = m\ \alpha\text{-cl}_x(F) \cap Y$, and since F is mα-closed in Y so $m\alpha\text{-cl}_Y(F) = F$. Then , $F = m\alpha\text{-cl}_x(F) \cap Y$. Since $q \notin F$, then $q \notin m\alpha\text{–cl}_x(F) \cap Y$, $q \notin m\alpha\text{-cl}_x(F)$, thus $m\alpha\text{-cl}_x(F)$ is mα-closed in X , and since (X,M,N) is mα-regular , then there exist two disjoint mα-open sets G , H in X , such that $q \in G$, $m\alpha\text{-cl}_x(F) \subseteq H$ and $G \cap H = \emptyset$. Hence $q \in G \cap Y$ and mα-clx $(F) \cap Y \subseteq H \cap Y$, $F \subseteq H \cap Y$, since G , H are mα-open in X then $G \cap Y$, $H \cap Y$ are mα-open set in Y . Since $G \cap H = \emptyset$, then $(G \cap Y) \cap (H \cap Y) = (G \cap H) \cap Y = \emptyset \cap Y = \emptyset$ .Therefore (Y, M_y, N_y) is mα-regular subspace of (X,M,N) .

3.7. Definition

Let (X, M, N) be biminimal space has the property $\mathcal{J}$, then (X, M, N) is called mα-normal space iff for each pair of mα-closed set G, H in X , such that $G \cap H = \emptyset$, there exists mα-open sets U , V such that $G \subseteq U$, $H \subseteq V$ and $U \cap V = \emptyset$.

3.8. Proposition

Let (X, M, N) be biminimal space has the property $\mathcal{J}$, then (X, M, N) is mα-normal space if (X, T) is normal space .

Let R, S be two M-closed set in X, such that $R \cap S = \emptyset$ Since (X, M) is normal space, then there exists G, H are M-open set in X such that $S \subseteq G$, $R \subseteq H$, $G \cap H = \emptyset$,but every M-open set is mα-open set by ((1.6) Remarks), then G, H are mα-open sets , such that $S \subseteq G$, $R \subseteq H$ and $G \cap H = \emptyset$. Hence (X, M, N) is mα -regular.

3.9. Remark

The converse of the above proposition is not correct, as shown in the following example .

3.10. Example

Let (X, M, N) be biminimal space has the property I, such that

X = { a, b, c, d } ,

M = { Ø , X , {a} , {a, d} , {b, c}, {c, d}, {a, b, c} } ,

N = { X , Ø } , such that :

mα-o(X)={ Ø ,X,{a},{a, d},{b, c},{c, d},{a, b, c},{a, b},{a, c},{a, c, d},{b, c, d},{a, b , d} }.

Then (X,M,N) is mα-normal space, but (X,M) is not m-normal space.

3.11. Theorem

Let (X, M, N) be biminimal space has the property $\mathcal{J}$.Then (X,M,N) is mα-normal space iff for every mα-closed set H in X and mα-open set U in X containing H , there exist mα-open set V, such that $H \subseteq V \subseteq m\alpha\text{-cl}(V) \subseteq U$.

Proof :

Suppose (X,M,N) is mα-normal space , let H be mα-closed in X and U is mα-open in X , such that $H \subseteq U$. Then U^c is mα-closed in X and $H \cap U^c = \emptyset$. So there exist mα-open sets V,K such that $U^c \subseteq K$, $H \subseteq V$, $V \cap K = \emptyset$, $K^c \subseteq U$, $V \subseteq K^c$ .This implies that $m\alpha\text{-cl}(V) \subseteq m\alpha\text{-cl}(K^c) = K^c$. Then $H \subseteq V \subseteq m\alpha\text{-cl}(V) \subseteq U$.

Conversely, let H and G be mα-closed sets in X such that $H \cap G = \emptyset$, then G^c is mα-open in X, and $H \subseteq G^c$. By hypothesis , there exist mα-open set V , such that $H \subseteq V$, $m\alpha\text{-cl}(V) \subseteq G^c$, then $G \subseteq (m\alpha\text{–cl}(V))^c$. So we have $H \subseteq V$, $G \subseteq (m\alpha\text{–cl}(V))^c$, and $V \cap (m\alpha\text{–cl}(V))^c = \emptyset$ .Therefore , (X,M,N) is mα-normal space**.**

3.12. Corollary

Let (X, M, N) be biminimal space has the property $\mathcal{J}$,then (X, M, N) is mα-normal space iff for each mα-closed set H in X and each mα-open set U in X containing H , there exists a subset A of X , such that $H \subseteq m\alpha\text{-int}(A) \subseteq m\alpha\text{-cl}(A) \subseteq U$.

Proof:

To prove 3.12. Corollary, we only replace the mα-open set V in 3.11. Theorem by a subset A of X with observing mα-int (V)=V. Thus, we have finished the proof.

3.13. Definition

Let (X, M, N) be biminimal space has the property $\mathcal{J}$,then (X, M, N) is called a mα-M_3 space iff X is mα-M_1 and mα-regular.

3.14. Remark

Every mα-M_3 space is mα-regular and the converse is not true in general (see 3.15. example below).

3.15. Example

Let X= {a, b, c}, M={ Ø, X, {b}, {a, c}}, N={ Ø, X, {c}}, then mα-o(X) = { Ø, X, {b}, {a, c}}.So, we have (X, M, N) is mα-regular space, but it is not mα-M1 space, therefor it is not mα-M_3 space.

3.16. Definition

Let (X, M, N) be biminimal space has the property $\mathcal{J}$, then (X,M,N) is called mα-M_4 space iff X is mα-normal and mα-M_1 space .

3.17. Remark

Every mα- M_4 space is mα-normal and the converse is not correct in general, (see in 3.15.Example , (X, M, N) is also mα-normal space but it is not mα-M1 space, therefor it is not mα-M4 space).

3.18. Proposition

Every mα- M_4 space is also mα-M_3 space.

Proof :

Let (X,M,N) be a mα-M_4 space , then (X,M,N) is mα-normal as well as mα-M_1 space . To prove that the space is mα-M_3 space , it suffices to show that the space is mα-regular .

Let F be a mα-closed subset of X and, let x be a point of X such that x $\notin$ F. Since (X,M,N) is a mα-M_1 space .Thus {x} is a mα-closed subset of X , such that {x} ∩ F = Ø , then by mα-normality , there exist mα-open sets disjoint G , H such that {x} ⊆ G, F ⊆ H .Also {x}⊆ G , then x∈G , then there exist mα-open sets G , H such that x∈G , F⊆ H and G∩ H = Ø .It follows that the space (X, M, N) is mα-regular .

5. REFERENCES

[1] Alimohammady, M. and Roohi M., Fixed Point in Minimal Spaces, Modelling and Control, Vol. 10, No. 4, 305-314, (2005).

[2] Alimohammady, M. and Roohi M., Delavar MR. Knaster-Kuratowski-Mazurkiewicz theorem in minimal generalized convex spaces, Nonlinear Funct Anal Appl, in press.

[3] Alimohammady, M. and Roohi M., Extreme points in minimal spaces. Chaos, Solitons & Fractals ;39(3):1480–5,(2009).

[4] Alimohammady, M. and Roohi M., Linear minimal space. Chaos, Solitons & Fractals, 33(4):1348–54,(2007).

[5] Boonpok, C. , Biminimal structure spaces, Int. Math. Forum, 5(15),703-707. (2010).

[6] Hashoosh, A .E. and Farawi Y.A. , Mδ-closed set in M-T_0-Alexandroff space. Journal of College of Euducation for pure science , vol.3 (1) ,(2013).

[7] Hashoosh, A .E., PRE-ALEXANDROFF SPACE, J.Thi-Qar Sci. Vol.3 (4), 2013.

[8] Hashoosh, A .E. and Farawi Y.A. , Mθ-closed set in M-T_0-Alexandroff space. Preprint, Journal of University of thi-qar , accepted (2014).

[9] Maki, H., Umehara J. and Noiri T. , Every topological space is pre $T_{½}$, Mem. Fac. Sci. Kochi Univ. Ser. Math, PP. 33-42 , (1950).

[10] Sharmil, A.S. and Arockia R. , "generalized preregular closed sets in minimal structure space.international journal of computer application , issue ,volume 5, 2250-1797. (2012).

Author's biography:

Author's Photo

Name: Hussein Khashan Kadhim

Nationality: Iraqi

Date and place of birth: 25/2/1982, Dhi-Qar Governorate, Nasiriyah city.

Status: married

Marital status:

Address: Dep. of math., college of education for pure sciences, university of Dhi-Qar

Mobile no. : 9647800167977

ISSN 2347-1921

Phone no.: 042236504

E-mail: Khashan_hussein@yahoo.com

Scientific title: Assistant lecturer in pure mathematics

Specialization: Mathematics(mathematics analysis)

Studies certification:

Certificate	Year	Specialization	Average	University	Country
Secondary school	2000	Scientific branch	74.43	……..	Iraq
B.Sc.	2005	Mathematics	76.47	Dhi-Qar	Iraq
M.Sc.	2012	Math. (Mathematical analysis)	80	Basrah	Iraq

Occupations:

-From 2005 to 2012: Assistant researcher in the Dep. of Math. , college of education for pure sciences , university of Dhi-Qar ,(Iraq).

-From 2013 up to now: Assistant lecturer in the Dep. of Math. , college of education for pure sciences , university of Dhi-Qar ,(Iraq).

-From 2014 up to now: Manger of data basis of college of education for pure sciences , university of Dhi-Qar ,(Iraq).

Published papers:

1− Three-mode bifurcation of extremals in the analysis of bifurcation solutions of sixth order differential equation, published in journal of college of education for pure sciences, college of education for pure sciences, university of Dhi-Qar ,(Iraq)(2013).

Teaching experience:

Place	Subject	Year
Second stage , dep. of math. , college of education for pure science , university of Dhi-Qar	Ordinary differential equations	2013 up to now
First stage , dep. of computer science, college of education for pure science , university of Dhi-Qar	Calculus	2013 up to now

No. of appreciation letters:

1) 16/1402 (Ministerial) in 25/8/2013

2) 16/181 (Ministerial) in 2/2/2014

3) 16/490 (Ministerial) in 13/3/2014

4) 1/1/4312 (Academic) in 23/3/2014.