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# Increasing Minimal g-open Sets of Type1

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Abstract **The definition of minimal open sets of Type1, minimal g-open sets of Type1 was introduced by [12]. In this article we instigate increasing-minimal open sets Type1, increasing-g-open sets of Type1, decreasing-minimal open sets of Type1, balanced-minimal g-open sets of Type1 and also we have proved that the class of iα-open sets ( resp. dα-open sets, bα-open sets,) properly contains in the class of i-minimal g-open sets of Type1 and also we investigate some there fundamental properties with several counter examples.:**

***Keywords — i-$m_i$O(Z, T1), i-$m_i$gO(Z, T1), d-$m_i$O(Z, T1), d-$m_i$gO(Z, T1), b-$m_i$O(Z, T1), b-$m_i$gO(Z, T1)***

## I. INTRODUCTION

L. Nachbin[6] Topology and order, D.Van Nostrand Inc., Princeton, New Jersy studied increasing [resp. decreasing, balanced] open sets in 1965. K. Bhagya Lakshmi, V. Amarendra Babu, M.K.R.S. Veera kumar [11] studied gαi-closed sets, gαd-closed sets, and gαb-closed sets in topological ordered spaces in 2015.

G.Venkareswarlu, V.Amarendra Babu, and M.K.R.S Veera kumar [12] introduced and studied minimal open sets of Type1 sets, minimal g-open sets of Type1 sets in 2016.

In this paper we introduce increasing-minimal open sets of Type1, Increasing-minimal g-open sets of Type1 (resp. d-minimal g-open sets of Type1, b-minimal g-open sets of Type1) sets and also We have proved that the class of iα-open sets ( resp. dα-open sets, bα-open sets,) properly contains in the class of i-minimal g-open sets of Type1 and also we investigate some there fundamental properties with several counter examples.

## II. PRELIMINARIES

**DEFINITION 2.1**: A subset A of a topological space (X, T) is called

1. a generalized closed set (brifly g-closed **[3]**) if cl(A) ⊆ U whenever A⊆ U and U is open in (X, T). The complement of a g-closed is called g-open set.
2. a Ψ –close set **[13]** if scl(A) whenever A⊆ U and U is sg-open in (X, α). The complement of a Ψ-closed is called Ψ-open set.
3. α-open set **[7]** if A⊆int(cl(int(A))) and α-closed if cl(int(cl(A)))⊆A.
4. Β-open set **[14]** if A⊆cl(int(cl(A))) and β-closed if int(cl(intA))⊆A.

**DEFINITION 2.2**: **[12 ]** In a topological space (X, T), an open sub set U of X is called a minimal open sets of Type! If ∃ at least one non-empty closed set F such that F⊆U or U = Φ.

**DEFINITION 2.2: [12]** In a topological space (X, T), an open sub set U of X is called a minimal g- open sets of Type! If ∃ at least one non-empty g- closed set F such that F⊆U or U = Φ.

**DEFINITION 2.3: [11]** A sub set A of a topological space (X, T, ≤) is called an iα (brifly dα- and bα-open set) if A is both α-open and increasing (resp. decreasing and balanced) set.

## III. 3. MAIN RESULT

Now we state and prove our first main result.

Before that we first introduce an increasing, decreasing and ballenced open sets in minimal g-open set of Type 1 sets and some notations.

**DEFINITION 3.1**: A subset A of a topological ordered space (Z, T, ≤) is called increasing minimal open sets of Type1 ( brifly i-$m_i$O(Z, T1) ) if A is both increasing and minimal open sets of Type1.

**DEFINITION 3.2** A subset A of a topological ordered space (Z, T, ≤) is called increasing minimal g- open **sets of Type1 ( brifly i-$m_i$gO(Z, T1) ) if A is both increasing and minimal g- open sets of Type1.**

**DEFINITION 3.3**: A subset A of a topological ordered space (Z, T, ≤) is called decreasing minimal g- open sets of Type1 ( brifly d-$m_i$gO(Z, T1) ) if A is both decreasing and minimal g- open sets of Type1.

**DEFINITION 3.4**: A subset A of a topological ordered space (Z, T, ≤) is called balanced minimal g- open

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sets of Type1 ( brifly b-$m_i$O(Z, T1) ) if A is both balanced and minimal g- open set of Type1.

**Note.3.5**:

The collections of all increasing minimal open sets of Type1, increasing minimal g-open sets

Type1, (resp. decreasing and balanced) set in topological ordered space is denoted by i-$m_i$O(Z, T1), i-

$m_i$gO(Z, T1) (resp. d-$m_i$O(Z, T1), d-$m_i$gO(Z, T1), b-$m_i$O(Z, T1), b-$m_i$gO(Z, T1).

**THEOREM3.6**: In a topological ordered space (Z, T, ≤), every i-$m_i$O(Z, T1) is an i-open set.

Proof. As for the fact, every i- $m_i$O(Z , T1) is $m_i$O(Z, T1) and that every $m_i$O(Z, T1) is i-open set.

**REMARK 3.7**:The converse of theorem 3.6 need not be true.

**EXAMPLE 3.8**: Let Z={ $i_1$, $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} } $\leq_7$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$),( $i_2$, $i_1$) }

$m_i$O(Z, T1) sets = { Φ,Z, {$i_1$, $i_2$},{$i_1$, $i_3$} }

i-$m_i$O(Z, T1) sets = { Φ,Z, {$i_1$, $i_2$},{$i_1$, $i_3$} }

open sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

i- open sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }. Then A = {$i_1$} is i-open set but not i-$m_i$O(Z, T1).

**THEOREM 3.9**: In a topological ordered space (Z, T, ≤), every d-$m_i$O(Z, T1) is an d-open set.

**Proof**: As for the fact, every d-$m_i$O(Z, T1) is $m_i$O(Z, T1) and that every $m_i$O(Z, T1) is d-open set.

**REMARK 3.10**: The converse of theorem 3.9 need not be true.

**EXAMPLE 3.11**: Let Z= { $i_1$, $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$} }

$\leq_1$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$),($i_1$, $i_2$),($i_1$, $i_3$),( $i_2$, $i_3$) }.

$m_i$O(Z, T1) = {Φ, Z}

d-$m_i$O(Z, T1) = {Φ, Z}

open sets = { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$} }.

d- open sets = { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$} }. Then B = {$i_1$} is d-open set but not d-$m_i$O(Z, T1).

**THEOREM 3.12**: In a topological ordered space (Z, T, ≤), every b-$m_i$O(Z, T1) is an b-open set.

**Proof**: As for the fact, every b-$m_i$O(Z, T1) is $m_i$O(Z, T1) and that every $m_i$O(Z, T1) is b-open set.

**REMARK 3.13**: The converse of theorem 3.12 need not be true.

**EXAMPLE 3.14**: Let Z={ $i_1$, $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$} } $\leq_7$ = {($i_1$, $i_1$), ( $i_2$, $i_2$),($i_3$, $i_3$),( $i_2$, $i_1$) }.

$m_i$O(Z, T1) = {Φ, Z}

b-$m_i$O(Z, T1) = {Φ, Z}

open set = { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$} }

b-open sets = { Φ, Z, {$i_1$, $i_2$} }. Then C = {$i_1$, $i_2$} is b-open set but not b-$m_i$O(Z, T1)

**The theorems of this sketch are given above.**

1.i-$m_i$gO(Z, T1) ⇔ i-$m_i$O(Z, T1) ⟹ i-open set.
2.d-$m_i$gO(Z, T1) ⇔ d-$m_i$O(Z, T1) ⟹ d-open set.
3.b-$m_i$gO(Z, T1) ⇔ b-$m_i$O(Z, T1) ⟹ b-open set.

**Diagram3.1**

**THEOREM 3.15:** In a topological ordered space (Z , T, ≤), Arbitary union of i-$m_i$O(Z, T1) is also i-$m_i$O(Z, T1).

**Proof**: $\{\mathcal{A}\}_{i\in\mathcal{I}}$ be a class of i-$m_i$O(Z, T1) ⟹ $\mathcal{A}_i$ is a i-$m_i$O(Z, T1) for each i∈$\mathcal{I}$ clearly $\cup_{i\in I} A_i$ is an open

set. If $\cup_{i\in I} A_i = \Phi$ then there is nothing to prove. Suppose $\cup_{i\in I} A_i \neq \Phi$ .Then there exist some j∈$\mathcal{I}$ such

that $\mathcal{A}_j$ is a i-$m_i$O(Z, T1)

⟹∃ a non-empty open set $\mathcal{B}$ such that $\mathcal{B} \subseteq A_j \Rightarrow \mathcal{B} \subseteq \cup_{i\in I} A_i$ . There for $\cup_{i\in I}\mathcal{A}_i$ is also a i-$m_i$O(Z, T1).

**THEOREM 3.16**: In a topological ordered space (Z, T, ≤), Arbitary union of i-$m_i$gO(Z, T1) is also i-$m_i$gO(Z, T1).

**Proof**: follows from the theorem 3.15

**THEOREM 3.17**: In a topological ordered space (Z, T, ≤), Arbitary union of d-$m_i$gO(Z, T1) is also d-$m_i$gO(Z, T1).

**Proof**: follows from the theorem3.15

**THEOREM 3.18**: Arbitary union of b-$m_i$gO(Z, T1) is also b-$m_i$gO(Z, T1).

**Proof**: follows from the theorem3.15

**THEOREM3.19**: In a topological ordered space (Z, T, ≤), Finite Intersection of i-$m_i$O(Z, T1) is also a i-$m_i$O(Z, T1).

**Proof**: Let Z={ $i_1$, $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$, $i_3$}},

$\leq_1$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$),($i_1$, $i_3$),( $i_2$, $i_3$) }.

$m_i$O(Z, T1) sets ={ Φ, Z,{$i_1$}, { $i_2$, $i_3$} }

i-$m_i$O(Z, T1) sets ={ Φ, Z, { $i_2$, $i_3$} }

finite intersection of i-$m_i$O(Z, T1) = Φ∈ i-$m_i$O(Z, T1).

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**THEOREM 3.20**: In a topological ordered space (Z, T, ≤), Finite Intersection of d-m$_i$gO(Z, T1) is also a d-m$_i$gO(Z, T1).

**Proof**: Let Z={ $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$ },{ $i_2$, $i_3$} },

$\leq_3$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$), ($i_1$, $i_3$) }.

m$_i$gO(Z, T1) sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, { $i_2$, $i_3$} }

d-m$_i$gO(Z, T1) sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$} }.

finite intersection of d-m$_i$gO(Z, T1) = Φ∈d-m$_i$gO(Z, T1).

**THEOREM 3.21**: In a topological ordered space (Z, T, ≤), Finite Intersection of b-m$_i$gO(Z, T1) is also a b-m$_i$gO(Z, T1).

**Proof**: Let Z={ $i_1$, $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$, $i_2$} }, $\leq_7$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$) }.

m$_i$gO(Z, T1) sets = { Φ, Z }

b-m$_i$gO(Z, T1) sets = { Φ, Z }

finite intersection of b-m$_i$gO(Z, T1) = Φ∈ b-m$_i$gO(Z , T1)

**THEOREM 3.22**: In a topological ordered space (Z, T, ≤), every i-m$_i$gO(Z, T1) is an iα-open set.

**Proof**: As for the fact, every i-m$_i$gO(Z, T1) is i-m$_i$O(Z, T1) and that every i-m$_i$O(Z, T1) is iα-open set.

**REMARK 3.23**: The converse of theorem 3.22 need not be true.

**EXAMPLE 3.24**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$ }

$\leq_2$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$), ( $i_3$, $i_2$) }.

m$_i$gO(Z, T1) sets = { Φ, Z }

i-m$_i$gO(Z, T1) sets = { Φ, Z }

α-open sets = { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$ }

iα- open serts = {Φ, Z, { $i_2$}, {$i_1$, $i_2$}. Then D = {$i_1$, $i_2$} is iα-open set but not i-m$_i$gO(Z, T1)

**THEOREM 3.25**: In a topological ordered space (Z, T, ≤), every b-m$_i$gO(Z, T1) is an bα-open set.

**Proof**: As for the fact, every b-m$_i$gO(Z, T1) is b-m$_i$O(Z, T1) and that every b-m$_i$O(Z, T1) is bα-open set.

**REMARK 3.26**: The converse of theorem 3.25 need not be true.

**EXAMPLE 3.27**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_3$ }, $\leq_7$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$) }.

m$_i$gO(Z, T1) sets = { Φ, Z }.

b-m$_i$gO(Z, T1) sets = { Φ, Z }.

α-open sets = { Φ, Z, { $i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$ } }.

bα-open sets = { Φ, Z, {$i_1$, $i_2$} }. Then the set E = {$i_1$, $i_2$} is bα-open set but not b-m$_i$gO(Z, T1).

**THEOREM 3.28**: In a topological ordered space (Z, T, ≤), every d-m$_i$gO(Z, T1) is an dα-open set.

**Proof**: As for the fact, every d-m$_i$gO(Z, T1) is d-m$_i$O(Z, T1) and that every d-m$_i$O(Z, T1) is dα-open set.

**REMARK 3.29**: The converse of theorem 3.28 need not be true.

**EXAMPLE 3.30**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_3$ },

$\leq_2$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$), ( $i_3$, $i_2$) }.

m$_i$gO(Z, T1) sets = { Φ, Z }.

d-m$_i$gO(Z, T1) sets = { Φ, Z }.

α-open sets = { Φ, Z, { $i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$ } }.

dα- open sets = { Φ, Z, {$i_1$, $i_3$} }. Then the set F = {$i_1$, $i_3$} is dα-open set but not d-m$_i$gO(Z, T1).

**THEOREM 3.31**: In a topological ordered space (Z, T, ≤), every i-m$_i$gO(Z, T1) is an dα-open set.

**Proof**: As for the fact, every i-m$_i$gO(Z, T1) is d-m$_i$O(Z, T1) and that every d-m$_i$O(Z, T1) is dα-open set.

**REMARK 3.32**: The converse of theorem 3.31 need not be true.

**EXAMPLE 3.33**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_3$ },

$\leq_1$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$), ($i_1$, $i_3$), ( $i_2$, $i_3$) }.

m$_i$gO(Z, T1) sets = { Φ, Z }

i-m$_i$gO(Z, T1) sets = { Φ, Z }.

α-open sets = { Φ, Z, { $i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$ } }.

dα-open sets = { Φ, Z, {$i_1$, $i_2$} }. Then the set G = {$i_1$, $i_2$} is dα-open set but not i-m$_i$gO(Z, T1).

**THEOREM 3.34**: In a topological ordered space (Z, T, ≤), every i-m$_i$gO(Z, T1) is an bα-open set.

**Proof**: As for the fact, every i-m$_i$gO(Z, T1) is b-m$_i$O(Z, T1) and that every b-m$_i$O(Z, T1) is bα-open set.

**REMARK 3.35**: The converse of theorem 3.34 need not be true.

**EXAMPLE 3.36**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_3$ }, $\leq_7$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$) }.

m$_i$gO(Z, T1) sets = { Φ, Z }.

i-m$_i$gO(Z, T1) sets = { Φ, Z }.

α-open sets = { Φ, Z, { $i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$ } }.


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bα- open sets = { Φ, Z, {$i_1$, $i_2$} }. Then the set H = {$i_1$, $i_2$} is bα-open set but not i-$m_i$gO(Z, T1).

**THEOREM 3.37**: In a topological ordered space (Z, T, ≤), every b-$m_i$gO(Z, T1) is an dα-open set.

**Proof**: As for the fact, every b-$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is dα-open set.

**REMARK 3.38**: The converse of theorem 3.37 need not be true.

**EXAMPLE 3.39**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} },

$\leq_6$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$),($i_1$, $i_3$), ( $i_2$, $i_3$) }.

$m_i$gO(Z, T1) sets = { Φ, Z, {$i_1$, $i_2$}, {$i_1$, $i_3$ } }

b-$m_i$gO(Z, T1) sets = { Φ, Z }.

α-open sets = { Φ, Z, { $i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$ } }

dα- open sets = { Φ, Z, {$i_1$, $i_2$} }. Then the set I= {$i_1$, $i_2$} is dα-open set but not b-$m_i$gO(Z, T1).

**THEOREM 3.40**: In a topological ordered space (Z, T, ≤), every b-$m_i$gO(Z, T1) is an iα-open set.

**Proof**: As for the fact, every b-$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is iα-open set.

**REMARK 3.41**: The converse of theorem 3.40 need not be true.

**EXAMPLE 3.42**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$, $i_3$} },

$\leq_2$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$),( $i_3$, $i_2$) }.

$m_i$gO(Z, T1) sets = { Φ, Z, {$i_1$}, { $i_2$, $i_3$} }

b-$m_i$gO(Z, T1) sets = { Φ, Z }.

α-open sers = { Φ, Z, {$i_1$}, { $i_2$, $i_3$} }

iα- open sets = { Φ, Z, {$i_2$, $i_3$} }. Then the set J = { $i_2$, $i_3$} is iα-open set but not b-$m_i$gO(Z, T1).

**THEOREM 3.43**: In a topological ordered space (Z, T, ≤),

every d-$m_i$gO(Z, T1) is an iα-open set.

**Proof**: As for the fact, every d-$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is iα-open set.

**REMARK 3.44**: The converse of theorem 3.43 need not be true.

Exi$_1$mple 3.45 Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} },

$\leq_7$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$) } }

$m_i$gO(Z, T1) sets = { Φ, Z, {$i_1$, $i_2$}, {$i_1$, $i_3$}

d-$m_i$gO(Z, T1) sets = { Φ, Z, {$i_1$, $i_2$} }.

open sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

iα-open sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }. Then the set K = { $i_1$} is iα-open set but not d-$m_i$gO(Z, T1).

**THEOREM 3.46**: In a topological ordered space (Z, T, ≤), every d-$m_i$gO(Z, T1) is an bα-open set.

**Proof**: As for the fact, every d-$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is bα-open set.

**REMARK 3.47**: The converse of theorem 3.46 need not be true.

**EXAMPLE 3.48**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$, $i_2$} }, $\leq_7$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$) } }

$m_i$gO(Z, T1) sets = { Φ, Z }.

d-$m_i$gO(Z, T1) sets = { Φ, Z }.

open sets = { Φ, Z, {$i_1$, $i_2$} }

bα- open sets = { Φ, Z, {$i_1$, $i_2$} }. Then the set K= { $i_1$, $i_2$ } is bα-open set but not d-$m_i$gO(Z, T1).

**THEOREM 3.48**: In a topological ordered space (Z, T, ≤), every i-$m_i$gO(Z, T1) is an iβ-open set.

**Proof**: As for the fact, every i-$m_i$gO(Z, T1) is i-$m_i$O(Z, T1) and that every i-$m_i$O(Z, T1) is iβ-open set.

**REMARK 3.49**: The converse of theorem 3.48 need not be true.

**EXAMPLE 3.50**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$ }

$\leq_5$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_3$), ( $i_2$, $i_3$) } }

$m_i$gO(Z, T1) sets = { Φ, Z }

i-$m_i$gO(Z, T1) sets = { Φ, Z }

β-open serts = {Φ, Z, { {$i_1$}, { $i_2$}, {$i_1$, $i_2$ }, {$i_2$, $i_3$}, {$i_1$, $i_3$ } }.

iβ-open sets = { Φ, Z, {$i_3$}, { $i_2$, $i_3$}, {$i_1$, $i_3$ } Then D = {$i_1$, $i_3$} is iβ-open set but not i-$m_i$gO(Z, T1)

**THEOREM 3.51**: In a topological ordered space (Z, T, ≤), every i-$m_i$gO(Z, T1) is an dβ-open set.

**Proof**: As for the fact, every i-$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is dβ-open set.

**REMARK 3.52**: The converse of theorem 3.51 need not be true.

**EXAMPLE 3.53**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, {$i_1$, $i_2$ },

$\leq_2$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$), ( $i_3$, $i_2$) }.

$m_i$gO(Z, T1) sets = { Φ, Z }

i-$m_i$gO(Z, T1) sets = { Φ, Z }.

β-open sets = { Φ, Z, { $i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$ } }.

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dβ-open sets = { Φ, Z, $\{i_1\}$, $\{i_1, i_3\}$ }. Then the set G = $\{i_1, i_3\}$ is dβ-open set but not i-$m_i$gO(Z, T1).

**THEOREM 3.54**: In a topological ordered space (Z, T, ≤), every i-$m_i$gO(Z, T1) is an bβ-open set.

**Proof**: As for the fact, every i-$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is bβ-open set.

**REMARK 3.55**: The converse of theorem 3.54 need not be true.

**EXAMPLE 3.56**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, $\{i_1\}$, $\{i_1, i_3\}$ },

$\leq_9$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$),( $i_1$, $i_3$) }

$m_i$gO(Z, T1) sets = { Φ, Z{ $i_2$}, $\{i_1, i_2\}$, $\{i_1, i_3\}$ }.

i-$m_i$gO(Z, T1) sets = { Φ, Z,{ $i_2$} }.

β-open sets = { Φ, Z, { $i_1$},{ $i_2$}, $\{i_1, i_2\}$, $\{i_1, i_3\}$ }.

bβ- open sets = { Φ, Z, { $i_2$ }, $\{i_1, i_3\}$ }. Then the set H = $\{i_1, i_3\}$ is bβ-open set but not i-$m_i$gO(Z, T1).

**THEOREM 3.57**: In a topological ordered space (Z, T, ≤), every d-$m_i$gO(Z, T1) is an dβ-open set.

**Proof**: As for the fact, every d-$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is dβ-open set.

**REMARK 3.58**: The converse of theorem 3.57 need not be true.

Example 3.59 Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, $\{i_1\}$, $\{i_1, i_3\}$ }, $\leq_7$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$),( $i_2$, $i_1$) }

$m_i$gO(Z, T1) sets = { Φ, Z }.

d-$m_i$gO(Z, T1) sets = { Φ, Z }.

β-open sets = { Φ, Z, { $i_1$}, $\{i_1, i_2\}$, $\{i_1, i_3\}$ }.

dβ- open sets = { Φ, Z, $\{i_1, i_2\}$ }. Then the set F = $\{i_1, i_2\}$ is dβ-open set but not d-$m_i$gO(Z, T1).

**THEOREM 3.60**: In a topological ordered space (Z , T, ≤), every d-$m_i$gO(Z, T1) is an iβ-open set.

**Proof**: As for the fact, every d-$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is iβ-open set.

**REMARK 3.61**: The converse of theorem 3.60 need not be true.

**EXAMPLE 3.62**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T = { Φ, Z, $\{i_1\}$, $\{i_2, i_3\}$ }, $\leq_3$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$), ($i_1$, $i_3$) }. $m_i$gO(Z, T1) sets = { Φ, Z, $\{i_1\}$, $\{i_2, i_3\}$}.

d-$m_i$gO(Z, T1) sets = { Φ, Z, $\{i_1\}$}.

β-open sets = { Φ, Z, $\{i_1\}$, { $i_2$ }, $\{i_3\}$,$\{i_1, i_2\}$,$\{i_2, i_3\}$, $\{i_1, i_3\}$}. iβ-open sets = { Φ, Z, { $i_2$ }, $\{i_3\}$, $\{i_2, i_3\}$ }. Then the set K = $\{i_2\}$ is iβ-open set but not d-$m_i$gO(Z, T1).

**THEOREM 3.63**: In a topological ordered space (Z, T, ≤), every d-$m_i$gO(Z, T1) is an bβ-open set.

**Proof**: As for the fact, every d-$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is bβ-open set.

**REMARK 3.64**: The converse of theorem 3.63 need not be true.

**EXAMPLE 3.65**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T = { Φ, Z, $\{i_1\}$, { $i_2$}, $\{i_1, i_2\}$, $\{i_1, i_3\}$ },

$\leq_{10}$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_3$, $i_1$), ( $i_2$, $i_3$),( $i_2$, $i_1$) }

$m_i$gO(Z, T1) sets = { Φ, Z, { $i_2$}, $\{i_1, i_2\}$, $\{i_1, i_3\}$}.

d-$m_i$gO(Z, T1) sets = { Φ, Z, { $i_2$}}.

B-open sets = { Φ, Z, { $i_2$ }, $\{i_3\}$,$\{i_1, i_2\}$, $\{i_1, i_3\}$, $\{i_2, i_3\}$}.

bβ-open sets = { Φ, Z, { $i_2$ }, $\{i_2, i_3\}$ }. Then the set K= $\{i_2, i_3\}$ is bβ-open set but not d-$m_i$gO(Z, T1).

**THEOREM 3.66**: In a topological ordered space (Z, T, ≤), every b-$m_i$gO(Z, T1) is an bβ-open set.

**Proof**: As for the fact, every b-$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is bβ-open set.

**REMARK 3.67**: The converse of theorem 3.66 need not be true.

Example 3.68 Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z,$\{i_1, i_2\}$ },

$\leq_9$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), $\{i_1, i_3\}$}.

$m_i$gO(Z, T1) sets = { Φ, Z }.

b-$m_i$gO(Z, T1) sets = { Φ, Z }.

β-open sets = { Φ, Z, { $i_1$}, { $i_2$ }, $\{i_1, i_2\}$, $\{i_2, i_3\}$, $\{i_1, i_3\}$}.

bβ-open sets = { Φ, Z, { $i_2$ }, $\{i_1, i_3\}$ }. Then the set E = $\{i_1, i_3\}$ is bβ-open set but not b-$m_i$gO(Z, T1).

**THEOREM 3.69**: In a topological ordered space (Z, T, ≤), every b-$m_i$gO(Z, T1) is an dβ-open set.

**Proof**: As for the fact, every b-$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is dβ-open set.

**REMARK 3.70**: The converse of theorem 3.69 need not be true.

Example 3.71 Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, $\{i_3\}$, $\{i_2, i_3\}$ },

$\leq_9$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$),( $i_1$, $i_3$) }

$m_i$gO(Z, T1) sets = { Φ, Z}

b-$m_i$gO(Z, T1) sets = { Φ, Z }.

β-open sets = { Φ, Z, { $i_3$}, $\{i_2, i_3\}$, $\{i_1, i_3\}$ }

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dβ- open sets = { Φ, Z, {$i_1$, $i_3$} }. Then the set I= {$i_1$, $i_3$} is dβ-open set but not b-$m_i$gO(Z, T1).

**THEOREM 3.72**: In a topological ordered space (Z, T, ≤), every b-$m_i$gO(Z, T1) is an iβ-open set.

**Proof**: As for the fact, every b-$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is iβ-open set.

**REMARK 3.73**: The converse of theorem 3.72 need not be true.

**EXAMPLE 3.74**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$ }, {$i_2$, $i_3$} }.

$\leq_1$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$),($i_1$, $i_2$),($i_1$, $i_3$),( $i_2$, $i_3$) }.

$m_i$gO(Z, T1) sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$}, { $i_2$, $i_3$}}.

b-$m_i$gO(Z, T1) sets = { Φ, Z }.

β-open sers = { Φ, Z, {$i_1$}, {$i_2$}, {$i_1$, $i_2$}, { $i_2$, $i_3$} }

iβ- open sets = { Φ, Z, {$i_1$, $i_2$}, {$i_2$, $i_3$} }. Then the set J = {$i_2$, $i_3$} is iβ-open set but not b-$m_i$gO(Z, T1).

**THEOREM** 3.75 In a topological ordered space (Z, T, ≤), every i-$m_i$gO(Z, T1) is an iΨ-open set.

**Proof**: As for the fact every i--$m_i$gO(Z, T1) is i-$m_i$O(Z, T1) and that every i-$m_i$O(Z, T1) is iΨ-open set.

**REMARK 3.76**: The converse of theorem 3.75 need not be true.

**EXAMPLE 3.77**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T= { Φ, Z, {$i_1$, $i_2$} }

$\leq_4$ = {($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$), ( $i_3$, $i_1$), {$i_3$, $i_2$}}

$m_i$gO(Z, T1) sets = { Φ, Z }

i-$m_i$gO(Z, T1) sets = { Φ, Z }.

Ψ- open sets = { Φ, Z, {$i_1$}, {$i_2$}, {$i_1$, $i_2$}}.

iΨ-open sets = { Φ, Z, {$i_2$}, {$i_1$, $i_2$} }. Then the set L = {$i_1$, $i_2$} is iΨ-open set but not i-$m_i$gO(Z, T1).

**THEOREM 3.78**: In a topological ordered space (Z,T, ≤), every d-$m_i$gO(Z, T1) is an dΨ-open set.

**Proof**: As for the fact, every d--$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is dΨ-open set.

**REMARK 3.79**: The converse of theorem 3.78 need not be true.

**EXAMPLE 3.80**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T={ Φ, Z, {$i_1$, $i_2$} }

$\leq_1$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_2$),($i_1$, $i_3$), ( $i_2$, $i_3$) }

$m_i$gO(Z, T1) sets = { Φ, Z, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

d-$m_i$gO(Z, T1) sets = { Φ, Z,{$i_1$, $i_2$} }.

Ψ-open sets = { Φ, Z,{$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

dΨ- open sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$} }. Then the set M = { $i_1$ } is dΨ-open set but not d-$m_i$gO(Z, T1).

**THEOREM 3.81**: In a topological ordered space (Z, T, ≤), every b-$m_i$gO(Z, T1) is an bΨ-open set.

**Proof**: As for the fact, every b--$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is bΨ-open set.

**REMARK 3.82**: The converse of theorem 3.81 need not be true.

**EXAMPLE 3.83**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T={ Φ, Z, {$i_1$, $i_2$} } $\leq_7$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$) }

$m_i$gO(Z, T1) sets = { Φ, Z }

b-$m_i$gO(Z, T1) sets = { Φ, Z }

Ψ- open sets = { Φ, Z, {$i_1$}, {$i_2$}, {$i_1$, $i_2$}}.

bΨ-open sets = { Φ, Z, {$i_1$, $i_2$} }. Then the set N = { $i_1$, $i_2$ } is bΨ-open set but not b-$m_i$gO(Z, T1).

**THEOREM 3.84**: In a topological ordered space (Z, T, ≤), every i-$m_i$gO(Z, T1) is an bΨ-open set.

**Proof**: As for the fact, every i--$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is bΨ-open set.

**REMARK 3.85**: The converse of theorem 3.84 need not be true.

Example 3.86 Let Z = { $i_1$ , $i_2$, $i_3$ } and T={ Φ, Z, {$i_1$}, {$i_1$, $i_3$} } $\leq_7$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_2$, $i_1$) }

$m_i$gO(Z, T1) sets = { Φ, Z }

i-$m_i$gO(Z, T1) sets = { Φ, Z }

Ψ-open sets = { Φ, Z,{$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

bΨ-open sets = { Φ, Z, {$i_1$, $i_2$} }. Then the set P = { $i_1$, $i_2$} is bΨ-open set but not i-$m_i$gO(Z, T1).

**THEOREM 3.87**: In a topological ordered space (Z, T, ≤), every i-$m_i$gO(Z, T1) is an dΨ-open set.

**Proof**: As for the fact, every i--$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is dΨ-open set.

**REMARK 3.88**: The converse of theorem 3.87 need not be true.

**EXAMPLE 3.89**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T={ Φ, Z, {$i_1$, $i_2$} }

$\leq_1$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ($i_1$, $i_3$), ( $i_2$, $i_3$) }

$m_i$gO(Z, T1) sets = { Φ, Z }

i-$m_i$gO(Z, T1) sets = { Φ, Z }

Ψ- open sets = { Φ, Z, {$i_1$}, {$i_2$}, {$i_1$, $i_2$}}.

dΨ- sets = { Φ, Z, {$i_1$}, {$i_1$, $i_2$} }. Then the set Q = { $i_1$ } is dΨ-open set but not i-$m_i$gO(Z, T1).

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**THEOREM 3.90**: In a topological ordered space (Z, T, ≤), every b-$m_i$gO(Z, T1) is an iΨ-open set.

**Proof**: As for the fact, every b--$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is iΨ-open set.

**REMARK 3.91**: The converse of theorem 3.89 need not be true.

**EXAMPLE 3.92**: Let Z = { $i_1$ , $i_2$, $i_3$} and T={ Φ, Z, {$i_1$} } ,

$\leq_{10}$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$), ( $i_3$, $i_1$), ( $i_2$, $i_3$),( $i_2$, $i_1$) }

$m_i$gO(Z, T1) sets = { Φ, Z }

b-$m_i$gO(Z, T1) sets = { Φ, Z }

Ψ-open sets = { Φ, Z,{$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

iΨ-open sets = { Φ, Z, {$i_1$}, {$i_1$, $i_3$} }. Then the set R = { $i_1$, $i_3$} is iΨ-open set but not b-$m_i$gO(Z, T1).

**THEOREM 3.93**: In a topological ordered space (Z , T, ≤), every b-$m_i$gO(Z, T1) is an dΨ-open set.

**Proof**: As for the fact, every b--$m_i$gO(Z, T1) is b-$m_i$O(Z, T1) and that every b-$m_i$O(Z, T1) is dΨ-open set.

**REMARK 3.94**: The converse of theorem 3.92 need not be true.

**EXAMPLE 3.95**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T={ Φ, Z, {$i_1$} } , $\leq_8$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$) }

$m_i$gO(Z, T1) sets = { Φ, Z }

b-$m_i$gO(Z, T1) sets = { Φ, Z }

Ψ-open sets = { Φ, Z,{$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

dΨ-open sets = { Φ, Z,{$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }.

Then the set S = { $i_1$, $i_2$ } is dΨ-open set but not b-$m_i$gO(Z, T1).

**THEOREM 3.96**: In a topological ordered space (Z, T, ≤), every d-$m_i$gO(Z, T1) is an iΨ-open set.

**Proof**: As for the fact, every d--$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is iΨ-open set.

**REMARK 3.97**: The converse of theorem 3.95 need not be true.

**EXAMPLE 3.98**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T={ Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$} } , $\leq_8$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ( $i_3$, $i_3$) }

$m_i$gO(Z, T1) sets = { Φ, Z }

d-$m_i$gO(Z, T1) sets = { Φ, Z }

Ψ-open sets = {Φ, Z, {$i_1$}, {$i_2$}, {$i_1$, $i_2$} {$i_2$, $i_3$}, {$i_1$, $i_3$}}

iΨ- open sets = {Φ, Z, {$i_1$}, { $i_2$}, {$i_1$, $i_2$} {$i_2$, $i_3$}, {$i_1$,$i_3$}}

Then the set T = { $i_1$, $i_2$ } is iΨ-open set but not d-$m_i$gO(Z, T1).

**THEOREM 3.99**: In a topological ordered space (Z, T, ≤), every d-$m_i$gO(Z, T1) is an bΨ-open set.

**Proof**: As for the fact, every d--$m_i$gO(Z, T1) is d-$m_i$O(Z, T1) and that every d-$m_i$O(Z, T1) is bΨ-open set.

**REMARK 3.100**: The converse of theorem 3.98 need not be true.

**EXAMPLE 3.101**: Let Z = { $i_1$ , $i_2$, $i_3$ } and T={ Φ, Z, {$i_1$}, {$i_1$, $i_3$} } , $\leq_9$ = { ($i_1$, $i_1$), ( $i_2$, $i_2$), ($i_3$, $i_3$), {$i_1$, $i_3$} }

$m_i$gO(Z, T1) sets = { Φ, Z }

d-$m_i$gO(Z, T1) sets = { Φ, Z }

Ψ-open sets = { Φ, Z,{$i_1$}, {$i_1$, $i_2$}, {$i_1$, $i_3$} }

bΨ- open sets = { Φ, Z, {$i_1$, $i_3$} }. Then the set W={ $i_1$, $i_3$ } is bΨ-open set but not d-$m_i$gO(Z, T1).

**The above results are shown in following diagram.**

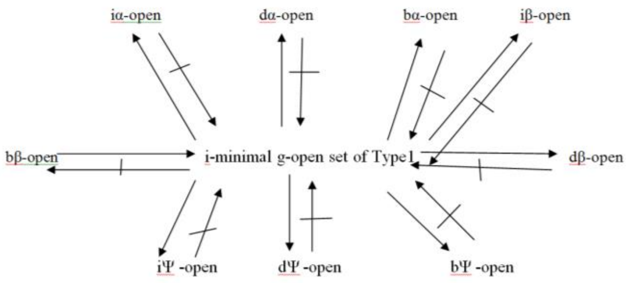


Diagram 3.1

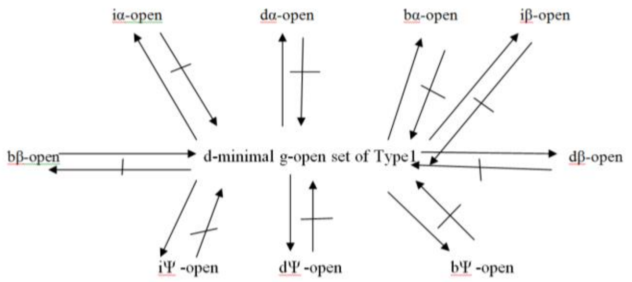


Diagram 3.2

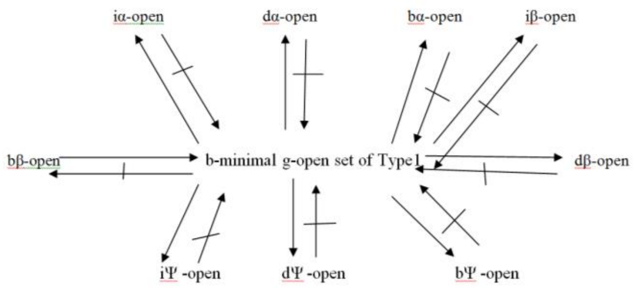


Diagram 3.3

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