P- ISSN 1991-8941 E-ISSN 2706-6703 *Journal of University of Anbar for Pure Science (JUAPS)* Open Access
2012,(6), (3) :101-105

Regular and Weak Regular in intuitionistic topological spaces

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ARTICLE INFO

Received: 12 / 5 /2011
Accepted: 7 / 3 /2012
Available online: 29/8/2013
DOI: 10.37652/juaps.2012.82139

Keywords:
Regular ,
Weak Regular ,
intuitionistic ,
topological spaces.

ABSTRACT

In this paper ,we introduce and study the concept of Regular and Weak Regular in intuitionistic topological spaces ,we find the relations among of the kinds of Regular space in intuitionistic topological spaces and the relation between of kinds of Weak Regular and the last , the relation between of themselves.

Introduction:

The concept of fuzzy set was introduced by Zadeh (1965) in his classical paper . A fuzzy set A in X is a function from X to unit interval [0,1] . For any x in X the number A(x) is called the membership degree of x in A.

After the discovery of the fuzzy subset , much attention has been paid to generalize the basic concept of classical topology in fuzzy setting and thus a modern theory of fuzzy topology has been developed .The nation of fuzzy subset naturally plays a very significant role in the study of fuzzy topology which was introduced by Chang C.L. in (1968) also Bayhan and Coker in (1996).

In 1983, Atanassov introduced the concept of "Intuitionistic fuzzy set" and Atanassov (1984) and (1986) using a type of generalized fuzzy set Coker (1997) , while a fuzzy set gives a degree of membership of an element in a given set ,intuitionistic fuzzy sets give both degree of membership and a non-membership .Both degrees belong to the interval [0,1] , and their sum should not exceed 1, formally an intuitionistic fuzzy set A in X was defined as an object of the form $A=\{\langle x, \mu_A(x), \gamma_A(x) : x \in X\rangle\}$, where $\mu_A(x)$ is called the degree of membership of x in A and $\gamma_A(x)$ the degree of non-membership of x in A, and $0 \leq \mu_A(x)+\gamma_A(x) \leq 1$, for each $x \in X$. Coker (1997)

After introducing the concept of fuzzy sets by Zadeh (1965) ,several researchers were conducted on generalizations of notion of fuzzy set , and after the idea of intuitionistic fuzzy set which the first published by Krassimir Atanassov (1988) , also Atanassov with Stoeva (1983) , many works appeared in the literature .Later , the concept is used to define intuitionistic fuzzy special sets by Coker (1996) , and intuitionistic fuzzy topological spaces are introduced by Coker (2000) , and Malghan ,R.S. with Benchalli,S.S. (1981) , also Fora A.A(1989) in "Separation axioms for fuzzy spaces" and separation axioms in intuitionistic fuzzy topological spaces by Bayhan ,S. and Coker, D. (1996), (2003) .In this direction , some preliminary concepts are also defined by Coker (1997) .Additionally , Coker,D. and Demiric ,M.(1995) defined fuzzy point , and Coker (1996) generalized intuitionistic points .

Bayhan and Coker (2001) "On separation axioms in ituitionistic topological spaces" and Abdullah (2007) introduced "Weak form for separation axioms in intuitionistic topological spaces" and Yaseen (2008) introduced another generalization of separation axioms also Mousa (2009) introduced more generalization on some separation axioms in ituitionistic topological spaces .

In this paper we introduced and study the concept of regular and weak regular in intuitionistic topological spaces , and study the relations of them with proved and given counter examples.

Preliminaries

Definition 2.1 [7] :

Let X be a non-empty set. An intuitionistic set A in X is an object having the form $A=\langle x, A_1, A_2\rangle$ where A_1 and A_2 are subsets of X satisfying the condition

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$A_1 \cap A_2 = \emptyset$. The set A_1 is called the set of member of A, while A_2 is called the set of non-member of A.

Definition 2.2 [7]:

Let X a non-empty set, and let $A=\langle x, A_1, A_2\rangle$ and $B=\langle x, B_1, B_2\rangle$ be two intuitionistic sets,furthermore let$\{A_i, i \in I\}$ be an arbitrary family of intuitionistic sets in X, where $A_i = \langle x, A_i^{(1)}, A_i^{(2)}\rangle$ .Then

1- $A \subseteq B$ if and only if $A_1 \subseteq B_1$ and $A_2 \supseteq B_2$.
2- $A=B$ if and only if $A \subseteq B$ and $B \subseteq A$.
3- The complement of an intuitionistic set A in X is denoted by $\bar{A}$ and defined by $\bar{\mathbf{A}}=\langle \mathbf{x}, \mathbf{A_2}, \mathbf{A_1}\rangle$.
4- $FA=\langle x, A_1, A_1^c\rangle$, $SA=\langle x, A_2^c, A_2\rangle$.
5- $\cup A_i=\langle x, \cup A_i^{(1)}, \cap A_i^{(2)}\rangle$, $\cap A_i=\langle x, \cap A_i^{(1)}, \cup A_i^{(2)}\rangle$.
6- $\tilde{\emptyset}=\langle x, \emptyset, X\rangle$, $\tilde{X}=\langle x, X, \emptyset\rangle$.
7- $\underline{\emptyset} = \langle x, \emptyset, A \subset X\rangle$.

Definition 2.3 [7]:

Let X be a non-empty set , $p \in X$ be a fixed element in X , and let $A=\langle x, A_1, A_2\rangle$ be an intuitionistic set (IS , for short) . The intuitionistic point $\tilde{p}$ in X (IP , for short) is an intuitionistic set defined by $\tilde{p}=\langle x, \{p\}, \{p\}^c\rangle$ .The vanishing intuitionistic point $\tilde{\tilde{p}}$ in X (VIP , for short) in an intuitionistic set defined by $\tilde{\tilde{p}}=\langle x, \emptyset, \{p\}^c\rangle$.

The IS $\tilde{p}$ is said to be contained in A ($\tilde{p} \in A$, for short) if and only if $p \in A_1$. And similarly $\tilde{\tilde{p}}$ contained in A ($\tilde{\tilde{p}} \in A$, for short) if and only if $p \notin A_2$.For a given IS A in X , we may write $A=(\cup \{\tilde{p}: \tilde{p} \in A\}) \cup (\cup \{\tilde{\tilde{p}}: \tilde{\tilde{p}} \in A\})$, and whenever A is not a proper IS (i.e. if A is not of the form $A=\langle x, A_1, A_2\rangle$ where $A_1 \cup A_2 \neq X$) ,then $A=\cup \{\tilde{p}: \tilde{p} \in A\}$ hold.

In general ,any IS A in X can be written in the form $A=\tilde{A} \cup \tilde{\tilde{A}}$ where $\tilde{A} = \cup \{\tilde{p}: \tilde{p} \in A\}$ and $\tilde{\tilde{A}} = \cup \{\tilde{\tilde{p}}: \tilde{\tilde{p}} \in A\}$.

Definition 2.4 [11] :

Let X and Y be two nonempty sets and $f: X \to Y$ be a function :

a) If $B = \langle x, B_1, B_2\rangle$ is an IS in Y . Then the preimage of B under f is denoted by $f^{-1}(B)$ is an IS in X and defined by $f^{-1}(B) = \langle x, f^{-1}(B_1), f^{-1}(B_2)\rangle$.
b) If $A=\langle x, A_1, A_2\rangle$ is an IS in X . Then the image of A under f denoted by $f(A)=\langle y, f(A_1), \underline{f}(A_2)\rangle$,where $\underline{f}(A) = (f(A_2^c))^c$.

Definition 2.5 [12] :

An intuitionistic topology on a nonempty set X is a family T of an intuitionistic sets in X satisfying the following conditions :

1) $\tilde{\emptyset}$, $X \in T$.
2) T is closed under finite intersections.
3) T is closed under arbitrary unions.

The pair (X,T) is called an intuitionistic topological space (ITS, for short) .Any element in T is usually called intuitionistic open set (IOS, for short).

The complement of an IOS in a ITS (X,T) is called intuitionistic closed set (ICS, for short) .

Definition 2.6 [7] :

Let (X,T) be an ITS . Then:
$T_{0,1}=\{FG : G = \langle x, G_1, G_2\rangle \in T\}$
$T_{0,2} =\{SG : G = \langle x, G_1, G_2\rangle \in T\}$, are intuitionistic topologies on X . Furthermore
$T^* = \{G_1 : G = \langle x, G_1, G_2\rangle \in T\}$,
$T^{**} = \{G_2^c : G = \langle x, G_1, G_2\rangle \in T\}$, are topologies on X.

Next, we give the definition of interior and closure of IS A in ITS (X,T).

Definition 2.7 [11] :

Let (X,T) be ITS and let $A=\langle x, A_1, A_2\rangle$ be an intuitionistic subset (IS's ,for short) in a set X. The interior (IntA ,for short) and closure (ClA ,for short) of a set A of X are defined:
$IntA=\cup \{G: G \subseteq A, G \in T\}$,
$ClA=\cap \{F: A \subseteq F, \bar{F} \in T\}$.

In other words : The IntA is the largest intuitionistic open set contained in A, and ClA is the smallest intuitionistic closed set contained A . i.e. , $IntA \subseteq A$ and $A \subseteq ClA$.

$3-Regular space in intuitionistic topological spaces :

Now, we introduce new definition of regular space in intuitionistic topological spaces.

Definition 3.1:

Let X be a non-empty set and T is an intuitionistic topology . Then (X,T) is said to be:

1- R(i) if for each $x \in X$ and $F \subseteq X$,F is an intuitionistic closed set and $\tilde{x} \notin F$, then there exist $U, V \in T$ such that $\tilde{x} \in U$, $F \subseteq V$ and $U \cap V = \tilde{\emptyset}$

2- R(ii) if for each x∈ X and F⊆X , F is an intuitionistic closed set and $\tilde{\tilde{x}}$ ∉F , then there exist U,V ∈T such that $\tilde{\tilde{x}}$ ∈U , F⊆V and U∩V=$\tilde{\emptyset}$
3- R(iii) if for each x∈X and F⊆X , F is an intuitionistic closed set and $\tilde{x}$ ∉F , then there exist U,V∈T such that $\tilde{x}$ ∈U , F⊆V and U⊆ $\overline{V}$
4- R(iv) if for each x∈X and F⊆X , F is an intuitionistic closed set and $\tilde{\tilde{x}}$ ∉F , then there exist U,V∈T such that $\tilde{\tilde{x}}$ ∈U , F⊆V and U⊆ $\overline{V}$.

In the following , we give the relation of the different kinds of R(k) where k∈ {i, ii, iii, iv}, which appears in definition 3.1 .

Theorem 3.2:

Let (X,T) be an intuitionistic topological space . Then the following implication are valid and the converse is not true in general :

$$\begin{tikzcd} R(ii) \arrow[r] \arrow[d] & R(i) \arrow[d] \\ R(iv) \arrow[r] & R(iii) \end{tikzcd}$$

Proof :

R(i)⟶R(ii)

Let (X,T) be satisfies R(i) if for each x∈X and F⊆X , F is an intuitionistic closed set and $\tilde{x}$ ∉F . Then there exist U,V∈T such that $\tilde{x}$ ∈U ,F⊆V and U∩V=$\tilde{\emptyset}$

$\tilde{x}$ ∈U⟺x∈U_1 and since U=$\langle x, U_1, U_2\rangle$ and $U_1 \cap U_2 = \emptyset$ that's implies x∉ U_2 ⟺ $\tilde{\tilde{x}} \in U$ and F⊆ $V, U \cap V = \tilde{\emptyset}$ therefore (X, T) is satisfies R(ii)

R(iii)⟶R(iv)

Let (X,T) is satisfies R(iii) if for each x∈ $X, F \subseteq X$,F is ICS and $\tilde{x} \notin F$. Then there exists U,V∈ T such that $\tilde{x} \in U$, $F \subseteq V$ and U⊆ $\overline{V}$

$\tilde{x} \in U$ ⟺ $x \in U_1$ and , since U=$\langle x, U_1, U_2\rangle$ and $U_1 \cap U_2 = \emptyset$ that's implies x∉ U_2 ⟺ $\tilde{\tilde{x}} \in U$ and F⊆ V , $U \subseteq \overline{V}$ therefore (X,T) is satisfies R(iv)

R(i)⟶R(iii)

Let (X,T) is satisfies R(i) if for each x∈ X , $F \subseteq X$,F is ICS and $\tilde{x} \notin F$. Then there exists U,V∈ T such that $\tilde{x} \in U$, $F \subseteq V$ and $U \cap V = \tilde{\emptyset}$

$\tilde{x} \in U \Rightarrow \tilde{x} \notin V$, since $U \cap V = \tilde{\emptyset}$

that's implies $\tilde{x} \in \overline{V}$,therefore U⊆ $\overline{V}$

therefore (X,T) is satisfies R(iii)

R(ii)⟶R(iv)

Let (X,T) is satisfies R(ii)if for each x∈X , F⊆ X , F is ICS and $\tilde{\tilde{x}} \notin F$. Then there exists U,V∈T such that $\tilde{\tilde{x}} \in U$, $F \subseteq V$ and U∩ $V = \tilde{\emptyset}$

$\tilde{\tilde{x}} \in U \Longrightarrow \tilde{\tilde{x}} \notin V$, since U∩ $V = \tilde{\emptyset}$

That's implies $\tilde{\tilde{x}} \in \overline{V}$, therefore U⊆ $\overline{V}$

Therefore (X,T) is satisfies R(iv)

Now , we give the examples to the reverse implications of theorem 3.2.

Example 3.3 :

R(ii)↛R(i)

Let X=$\{a, b, c\}$, $T = \{\tilde{\emptyset}, \tilde{X}, A, B, \overline{B}, \overline{A}\}$ where A=$\langle x, \{a, b\}, \{c\}\rangle$,B=$\langle x, \emptyset, \{a, b\}\rangle$ For each a∈ X , $\tilde{\tilde{a}} \notin F$. Then there exist U,V such that U=A and V=$\overline{A}$ and U∩ $V = \tilde{\emptyset}$

$\tilde{\tilde{a}} \in A$, $\tilde{\tilde{a}} \notin \overline{A} \subseteq \overline{A}$, $A \cap \overline{A} = \tilde{\emptyset}$

$\tilde{\tilde{b}} \in A$, $\tilde{\tilde{b}} \notin B \subseteq B$, $A \cap B = \tilde{\emptyset}$

$\tilde{\tilde{c}} \in C$, $\tilde{\tilde{c}} \notin A \subseteq A$, $C \cap A = \tilde{\emptyset}$

Therefore (X,T) is satisfies R(ii)

But $\tilde{c} \in \overline{A}$, $\tilde{c} \notin \overline{B} \subseteq \overline{B}$, $\overline{A} \cap \overline{B} \neq \tilde{\emptyset}$

Therefore (X,T) is not satisfies R(i)

Example 3.4 :

R(iii)↛R(i)

Let X=$\{a, b, c\}$, T=$\{\tilde{\emptyset}, \tilde{X}, A, \overline{A}\}$ where A=$\langle x, \{a, b\}, \emptyset\rangle$

For each a∈ X , $\tilde{a} \notin F$. Then there exists U,V such that U=A and V=$\overline{A}$ and U∩ $V = \tilde{\emptyset}$

$\tilde{a} \in A$, $\tilde{a} \notin \overline{A} \subseteq \overline{A}$, $A \subseteq A$

$\tilde{b} \in A$, $\tilde{b} \notin \overline{A} \subseteq \overline{A}$, $A \subseteq A$

Therefore (X,T) is satisfies R(iii)

But $\tilde{a} \in A$, $\tilde{a} \notin \overline{A} \subseteq \overline{A}$, $A \cap \overline{A} \neq \tilde{\emptyset}$

Therefore (X,T) is not satisfies R(i)

Example 3.5 :

1. R(iv)↛R(iii)

Let X=$\{a, b, c\}$, $T = \{\tilde{\emptyset}, \tilde{X}, A, B, \overline{A}\}$ where A=$\langle x, \{a\}, \emptyset\rangle$, B=$\langle x, \{a, c\}, \emptyset\rangle$, for each a∈ X , $\tilde{\tilde{a}} \notin F$. Then there exists U,V such that U=A and V=$\overline{A}$ and U∩ $V = \tilde{\emptyset}$

$\tilde{\tilde{a}} \in A$, $\tilde{\tilde{a}} \notin \overline{A} \subseteq \overline{A}$, $A \subseteq A$

$\tilde{\tilde{c}} \in A$, $\tilde{\tilde{c}} \notin \overline{B} \subseteq \overline{A}$, $A \subseteq A$

Therefore (X,T) is satisfies R(iv)

But $\tilde{c} \in B$, $\tilde{c} \notin \overline{B} \subseteq \overline{A}$, $B \nsubseteq A$

Therefore (X,T) is not satisfies R(iii)

2. R(iv)↛R(ii)

Recall example 3.5 and when (X,T) satisfies R(iv) , then (X,T) is not satisfies R(ii) ,because , $\tilde{\tilde{a}} \in A$, $\tilde{\tilde{a}} \notin \overline{A} \subseteq \overline{A}$, $A \cap \overline{A} \neq \tilde{\emptyset}$.

In this theorem , we give the condition to get the new theorem difficult of the theorem 3.2 (this theorem 3.6 is a weak of theorem 3.2) .

Theorem 3.6 :

Let (X,T) be an ITS , and for each A=$\langle x, A_1, A_2\rangle$ and $A_1 \cup A_2 = X$. Then:

1- R(i)⇔R(ii)
2- R(ii)⇔R(iv)
3- R(iii)⇔R(iv)
4- R(i)⇔R(iii)

Proof :

1- R(i)⇔R(ii)

We were proving R(i)⟹R(ii) , now we want to prove R(ii)⟹R(i) , let (X,T) is satisfies R(ii) if for each x∈ X , $F \subseteq X$, F is ICS and $\tilde{\tilde{x}} \notin F$ there exists U,V∈ T such that $\tilde{\tilde{x}} \in U$, $F \subseteq V$ and U∩ $V = \tilde{\emptyset}$,

$\tilde{\tilde{x}} \in U \Leftrightarrow x \notin U_2 \implies x \in U_1$, since $U_1 \cup U_2 = X$, then if x∈ U_1 then $\tilde{x} \in U$ (by the relation $\tilde{x} \in U \Leftrightarrow x \in U_1$)

Therefore (X,T) is satisfies R(i).

2- R(ii)⇔R(iv)

We were proving R(ii)⟹R(iv) , now we want prove R(iv)⟹R(ii) , let (X,T) is satisfies R(iv) if for each x∈ X , $F \subseteq X$, F is ICS and $\tilde{\tilde{x}} \notin F$ there exists U,V∈ T such that $\tilde{\tilde{x}} \in U$, $F \subseteq V$ and U⊆ $\overline{V}$.

$\tilde{\tilde{x}} \in U \implies \tilde{\tilde{x}} \in \overline{V}$and that's mean x∉ $V_1 \implies x \in V_2$, since $V_1 \cup V_2 = X$, therefore $\tilde{\tilde{x}} \notin V$ that's implies U∩ $V = \tilde{\emptyset}$.

Therefore (X,T) is satisfies R(ii).

3-R(iii)⇔R(iv)

We were proving R(iii)⟹R(iv) , now we want to prove R(iv)⟹R(iii) , let (X,T) is satisfies R(iv)if for each x∈ X , $F \subseteq X$, F is ICS and $\tilde{\tilde{x}} \notin F$ there exists U,V∈ T such that $\tilde{\tilde{x}} \in U$, $F \subseteq V$ and U⊆ $\overline{V}$.

From (1) and (2) we can say ($\tilde{\tilde{x}} \in U \implies \tilde{x} \in U$ and U⊆ $\overline{V} \implies U \cap V = \tilde{\emptyset}$) , therefore (X,T) is satisfies R(iii).

4-R(i)⇔R(iii)

We were proving R(i)⟹R(iii) , now we want to prove R(iii)⟹R(i) in a similar way.

Weak Regular space in intuitionistic topological spaces :

Now, we introduce new definition of weak regular space in intuitionistic topological spaces.

Definition 4.1 :

Let X be anon-empty set , and T be an IT . Then (X,T) is said to be :

1- wR(i) if for each x∈ X , F⊆ X , F is ICS and $\tilde{x} \notin F$ there exists U,V∈ T such that $\tilde{x} \in U$, $F \subseteq V$ and U∩ $V = \underline{\emptyset}$.
2- wR(ii) if for each x∈ X , $F \subseteq X$, F is ICS and $\tilde{\tilde{x}} \notin F$ there exists U,V∈ T such that $\tilde{\tilde{x}} \in U$, $F \subseteq V$ and U∩ $V = \underline{\emptyset}$.

In the last , we give the relation of the different kinds of wR(k) where k∈ $\{i, ii,\}$ and kind of R(k) where k∈ $\{i, ii,\}$, which appears in definition 4.1 and definition 3.1 .

Theorem 4.2 :

Let (X,T) be an ITS . Then the following implications are valid and the converse is not true in general :

$$\begin{tikzcd} wR(ii) \arrow[r] & wR(i) \\ R(ii) \arrow[u] \arrow[r] & R(i) \arrow[u] \end{tikzcd}$$

Proof :

wR(i)⟶wR(ii)

Let (X,T) is satisfies wR(i) if for each x∈ X , $F \subseteq X$,F is ICS and $\tilde{x} \notin F$. Then there exists U,V∈ T such that $\tilde{x} \in U$, $F \subseteq V$ and U∩ $V = \underline{\emptyset}$

And since $\tilde{x} \in U \implies \tilde{\tilde{x}} \in U$ from the above prove of theorem 3.2

R(i)⟶wR(i)

Let (X,T) is satisfies R(i) if for each x∈ X , $F \subseteq X$, F is ICS and $\tilde{x} \notin F$. Then there exists U,V∈ T such that $\tilde{x} \in U$, $F \subseteq V$ and U∩ $V = \tilde{\emptyset}$ and since $\tilde{\emptyset} \subseteq \underline{\emptyset}$, thus $\tilde{\emptyset} \implies \underline{\emptyset}$.

Therefore (X,T) is satisfies wR(i)

In a similar way we can prove R(ii)⟶wR(ii).

The reserve implication in theorem 4.2 are not true in general , the following counter example show the cases.

Example 4.3 :

wR(i)↛R(i)

Let X=$\{a, b, c\}$, $T = \{\tilde{\emptyset}, \tilde{X}, A, B, \overline{B}\}$ where A=$\langle x, \{c\}, \{a, b\}\rangle$, B=$\langle x, \{a, b\}, \emptyset\rangle$, for each a∈ X , $\tilde{a} \notin F$. Then there exists U,V such that U=B and V=$\overline{B}$ and U∩ V $= \underline{\emptyset}$

$\tilde{a} \in B$, $\tilde{a} \notin \overline{B} \subseteq \overline{B}$, $B \cap \overline{B} = \underline{\emptyset}$

$\tilde{b} \in B$, $\tilde{b} \notin \overline{B} \subseteq \overline{B}$, $B \cap \overline{B} = \underline{\emptyset}$

$\tilde{c} \in A$, $\tilde{c} \notin \overline{A} \subseteq B$, $A \cap B = \underline{\emptyset}$,

Therefore , (X,T) is satisfies wR(i).

But $\tilde{a} \in B$, $\tilde{a} \notin \overline{B} \subseteq \overline{B}$, $B \cap \overline{B} \neq \tilde{\emptyset}$,

Therefore , (X,T) is not satisfies R(i).

Example 4.4 :

1. wR(ii)↛R(ii)

Let $X=\{a,b,c\}$, $T=\{\tilde{\emptyset},\tilde{X},A,B,C\}$ where $A=\langle x,\{a\},\{c\}\rangle$, $B=\langle x,\{b,c\},\{a\}\rangle$, $C=\langle x,\emptyset,\{a,c\}\rangle$, for each $a\in X$, $\tilde{\tilde{a}}\notin F$. Then there exists U,V such that U=A and V=B and $U\cap V=\underline{\emptyset}$

$\tilde{\tilde{a}}\in A, \tilde{\tilde{a}}\notin \overline{A}\subseteq B, A\cap B=\underline{\emptyset}$

$\tilde{\tilde{b}}\in C, \tilde{\tilde{b}}\notin \overline{B}\subseteq A, C\cap A=\underline{\emptyset}$

$\tilde{\tilde{c}}\in B, \tilde{\tilde{c}}\notin \overline{B}\subseteq A, B\cap A=\underline{\emptyset}$,

Therefore , (X,T) is satisfies wR(ii) .

But $\tilde{\tilde{a}}\in A, \tilde{\tilde{a}}\notin \overline{A}\subseteq B, A\cap B\neq\tilde{\emptyset}$,

Therefore , (X,T) is not satisfies R(ii) .

2. $wR(ii)\nrightarrow wR(i)$

Recall example 4.4 and when (X,T) satisfies wR(ii) , then (X,T) is not satisfies wR(i), because , $\tilde{b}\in B, \tilde{b}\notin \overline{A}\subseteq B, B\cap B\neq\underline{\emptyset}$.

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الانتظام والانتظام الضعيف في الفضاءات التبولوجية الحدسية

يونس جهاد ياسين رند احمد محمد

الخلاصة :

في هذا البحث سنعرف مفهومي الانتظام والانتظام في الفضاءات التبولوجية الحدسية , كما وسنقوم بإيجاد العلاقات بين أنواع الانتظام في الفضاءات التبولوجية الحدسية , وكذلك سنجد العلاقة بين نوعي الانتظام الضعيف ومن ثم أيجاد العلاقة بين الانتظام والانتظام الضعيف في الفضاءات التبولوجية الحدسية .