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FUZZY gp*-CLOSED SETS IN FUZZY TOPOLOGICAL SPACE

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Abstract: In this paper fuzzy gp*- closed sets, fuzzy gp* continuous functions, fuzzy gp*-irresolute functions, fuzzy gp*-connectedness and fuzzy T*gp-space are introduced and also their relation with some other fuzzy sets and some of their properties are investigated.

Keywords and Phrases: Fuzzy topological spaces; fuzzy gp*-closed sets; fuzzy gp* continuous functions and fuzzy gp*-irresolute functions; fuzzy gp*-open sets; fuzzy T*gp-space.

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1. Introduction

Fuzzy set theory as introduced by Lotfi A. Zadeh [1] in 1965 is the expansion of the classical set theory and it expanded the basic definition of the classical or crisp sets. So fuzzy mathematics is just a kind of mathematics developed in this framework and fuzzy topology introduced by C.L Chang [2] in 1968 is the generalization of ordinary topology in classical mathematics. Since the introduction of fuzzy sets and fuzzy topological spaces, work started taking place at a good rate in this field of mathematics and various types of fuzzy sets were introduced and studied by various researchers, Like S.S Benchalli and G.P.Siddapur introduced fuzzy g* pre continuous maps[3], Hamid Reza Moradi and Anahid Kamali introduced fuzzy strongly g* -closed sets and g**-closed sets in 2015 [4], And almost all the mathematical, engineering, medicinal etc concepts have been redefined using fuzzy theory and it has further deepened the understanding of basic set theory.

In this paper fuzzy gp*- closed sets is defined and its relation with other sets like fuzzy closed sets, fuzzy g*-closed sets and g*p-closed sets are found and also some other properties of these sets are investigated. Moreover fuzzy gp*-open sets are introduced and their relation with other fuzzy sets are found. Fuzzy gp*- continuous function and fuzzy gp*-irresolute functions are defined and their relation with other fuzzy functions are investigated, also investigated some other properties of these functions. Fuzzy gp*-connectedness and fuzzy T*gp-spaces in fuzzy topological spaces are also introduced and some of their properties are investigated.

2. Preliminaries

Definition 2.1. [1] *Let X be a space of objects, with a generic element of X denoted by x. Then a fuzzy set A in X is a set of ordered pairs* $\{(x, f(x))\}$ *where* $f_A(x)$ *is called the membership function which associates each point in X a real number in the interval [0,1].*

Definition 2.2. [2] *A family* τ *of fuzzy sets of X is called fuzzy topology on X if 0 and 1 belong to* τ *and* τ *is closed with respect to arbitrary union and finite intersection. The elements of* τ *are called fuzzy open sets and there complements are called fuzzy closed sets. The space X with topology* τ *is called fuzzy topological space denoted by (X,*τ*).*

Definition 2.3. [2] *For a fuzzy set* α *of* X*, the closure cl* α *and the interior int* α *of* α *are defined respectively, as*
$cl\alpha = \wedge\{\mu : \mu \geq \alpha, 1 - \mu \in \tau\} and$
$int\alpha = \vee\{\mu : \mu \leq \alpha, \mu \in \tau\}$

Definition 2.4. [5] *A subset A of X is called fuzzy pre-closed (in short pcl) set if* $A \leq cl(int(A))$ *and fuzzy pre-open set if* $A \leq int(cl(A))$*.*

Definition 2.5. [4] *Let* (X, τ) *be a fuzzy topological space. A fuzzy set A of* (X, τ) *is called fuzzy strongly g*-closed if* $cl(int(A)) \leq H$*, whenever* $A \leq H$ *and H is fuzzy generalized -open in X.*

Definition 2.6. [6] *A fuzzy set A of a fuzzy topological space* (X, τ) *is called a fuzzy generalized star closed or* $g*-closed$ *if* $cl(A) \leq O$ *whenever* $A \leq O$ *and O is fuzzy generalized-open or g-open.*

Definition 2.7. [7] *A fuzzy set A of a fuzzy topological space* (X, τ) *is called fuzzy generalized closed or g-closed if* $cl(A) \leq G$ *whenever* $A \leq G$ *and* $G \in \tau$ *and is called fuzzy generalized open or g-open if* $1 - A$ *is fuzzy g-closed.*

Definition 2.8. [8] *A fuzzy set A of a fuzzy topological space* (X, τ) *is called fuzzy* *generalized pre -closed or gp-closed set if $pcl(A) \leq U$ whenever $A \leq U$ and U is a fuzzy open set in (X, τ). And complement of a Fuzzy gp-closed set is called fuzzy generalized pre-open or gp-open set.*

Definition 2.9. [3] *A fuzzy set A of a fuzzy topological space (X, τ) is called a fuzzy generalized star pre-closed (briefly g*p-closed) set if $pcl(A) \leq U$ whenever $A \leq U$ and U is fuzzy g-open set in (X, τ).*

Definition 2.10. [2] *A function f from a fts (X, τ) to a fts (Y, δ) is fuzzy-continuous iff the inverse of each δ-open fuzzy set in Y is τ-open fuzzy set in X.*

Definition 2.11. [9] *A function f from a fts (X, τ) to a fts (Y, δ) is fuzzy g^*-continuous if $f^{-1}(A)$ is fuzzy g^*-closed in X for every fuzzy closed set of Y.*

Definition 2.12. [10] *A fuzzy topological space X is said to be fuzzy connected if it has no proper fuzzy clopen set, (A fuzzy set λ in X is proper if $\lambda \neq 0$ and $\lambda \neq 1$, clopen means closed-open).*

Definition 2.13. [9] *A fuzzy topological space (X, τ) is called a fuzzy $T^*_{1/2}$ space if every g^*-closed fuzzy set is a closed fuzzy set.*

Definition 2.14. [3] *A fts (X, τ) is called a fuzzy-T^*_p - space if every g^*p closed fuzzy set is closed fuzzy set.*

Theorem 1. *Every fuzzy generalized-closed set is fuzzy generalized pre-closed set.*
Proof. Let θ is a fuzzy g-closed set and μ be a fuzzy open set such that $\theta \leq \mu$, then $cl(\theta) \leq \mu$ and hence $pcl(\theta) \leq cl(\theta) \leq \mu$ implies θ is a fuzzy gp-closed set.

Theorem 2. *All fuzzy generalized open sets are fuzzy generalized pre-open sets.*
Proof. Consider θ is a fuzzy generalized open set. Then (1- θ) is a fuzzy generalized closed set. Now by Theorem 1, (1-θ) is a fuzzy generalized pre closed set implying that θ is a fuzzy generalized pre-open set.

3. Fuzzy gp*-closed sets

Definition 3.1. *A fuzzy set λ of a fuzzy topological space (fts) (Y, τ) is called fuzzy generalized pre star closed (briefly fuzzy gp*-closed) if $cl(\lambda) \leq \mu$ whenever $\lambda \leq \mu$ and μ is fuzzy generalized pre-open in Y.*

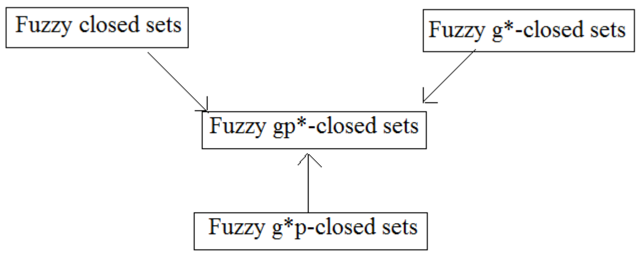
Example 3.2. Let $Y = \{y\}$ and $\tau = \{0_Y, y_{2/3}, y_{3/4}, 1_Y\}$. Then in this fuzzy topological space (Y, τ), fuzzy sets 0_Y, $A = y_{1/3}$, $B = y_{1/4}$ and 1_Y satisfy the condition $cl(\lambda) \leq \mu$ whenever $\lambda \leq \mu$ and μ is fuzzy generalized pre-open in Y. Implying 0_Y, $A = y_{1/3}$, $B = y_{1/4}$ and 1_Y are fuzzy gp*-closed sets in (Y, τ).

Theorem 3.3. *All fuzzy closed sets are fuzzy gp* closed sets.*
Proof. Consider θ is a fuzzy closed set in fuzzy topological space Y and μ is a fuzzy generalized pre- open set in Y containing $cl(\theta) \leq \theta = \mu$. Implying that $\theta$is a fuzzy gp*-closed set in Y.

Theorem 3.4. *All fuzzy generalized star pre-closed sets are fuzzy gp* closed.*
Proof. Consider σ is any arbitrary fuzzy generalized star pre closed set in fuzzy topological space (Y, τ). Let σ is contained in fuzzy generalized open μ. Now as every fuzzy generalized open set is fuzzy generalized pre-open set (By Theorem 2) so $pcl(\sigma) \leq cl(\sigma) \leq \mu$. Implying $cl(\sigma) \leq \mu$, Which in turn implies that σ is fuzzy gp*-closed.

Theorem 3.5. *All fuzzy g*-closed sets are fuzzy gp*-closed sets.*
Proof. Consider θ is a fuzzy g*-closed set in fuzzy topological space (Y, τ) and μ is any generalized-open set that contains θ. Now as every fuzzy generalized-open set is fuzzy generalized pre-open set (By theorem 2), so $cl(\theta) \leq \mu$, where μ is a fuzzy generalized pre-open set in Y. Implying that θ is fuzzy gp*-closed set.

Remark 3.6. *The following diagram depicts the relation of fuzzy gp*-closed set and other fuzzy sets discussed above.*



Theorem 3.7. *The Union of two fuzzy gp*-closed sets Δ and ∇ in fuzzy topological space (Y, τ) is also fuzzy gp*-closed set in Y.*
Proof. Suppose that Δ and ∇ are two fuzzy gp*-closed sets in Y. Let μ be a fuzzy generalized pre-open set that contains both Δ and ∇. so $cl(\Delta) \leq \mu$ and

$cl(\nabla) \leq \mu$. Now, as $\Delta \leq \mu$ and $\nabla \leq \mu$ implying that $\Delta \cup \nabla \leq \mu$ which inturn implies $cl(\Delta \cup \nabla) = cl(\Delta) \cup cl(\nabla) \leq \mu$, which gives the required result i.e $\Delta \cup \nabla$ is also a fuzzy gp*-closed set in Y.

Theorem 3.8. *If Δ and ∇ are two fuzzy gp*-closed sets in fuzzy topological space (Y, τ) then $\Delta \cap \nabla$ is also fuzzy gp*-closed in Y.*
Proof. Suppose $\Delta \& \nabla$ are two fuzzy gp*-closed sets in fuzzy topological space Y, such that $\Delta \leq \mu$ and $\nabla \leq \mu$, where μ is a fuzzy generalized pre-open set in Y. Then $cl(\Delta) \leq \mu$, $cl(\nabla) \leq \mu$ therefore $cl(\Delta \cap \nabla) \leq \mu$, where μ is fuzzy generalized pre-open set in Y. Which implies that $\Delta \cap \nabla$ is also fuzzy gp*-closed set in Y.

Theorem 3.9. *Suppose that μ is fuzzy gp*-closed set in fuzzy topological space Δ such that $\mu \leq \nabla \leq \Delta$, then μ is also fuzzy gp*-closed relative to ∇.*
Proof. Given that $\mu \leq \nabla \leq \Delta$, where μ is fuzzy gp*-closed in Δ. Now suppose that $\mu \leq \nabla \cap \theta$, where θ is fuzzy generalized pre-open in Δ. As μ is fuzzy gp*-closed, $\mu \leq \theta$ implies $cl(\mu) \leq \theta$. Which implies that $\nabla \cap cl(\mu) \leq \nabla \cap \theta$ i.e μ is also fuzzy gp*-closed relative to ∇.

4. Fuzzy gp*-open sets

Definition 4.1. *Suppose a fuzzy set λ is fuzzy generalized pre star closed set in fts (Y, τ), Then its complement i,e $1 - \lambda$ is called fuzzy generalized pre star open (briefly fuzzy gp*-open) in (Y, τ).*

Example 4.2. In the fuzzy topological space (Y, τ) defined in example 3.2, the complements of the fuzzy gp*-closed sets 0_Y, $A = y_{1/3}$, $B = y_{1/4}$ and 1_Y are respectively as 1_Y, C=$y_{2/3}$, D=$y_{3/4}$ and 0_Y. Implying 1_Y, C=$y_{2/3}$, D=$y_{3/4}$ and 0_Y are fuzzy gp*-open sets in (Y, τ).

Theorem 4.3. *All fuzzy open sets are fuzzy gp*-open.*
Proof. Consider μ is a fuzzy open set in fuzzy topological space (Y, τ), implies $1-\mu$ is a fuzzy closed set. Now from the theorem 3.3 all fuzzy closed sets are fuzzy gp*-closed sets. So $1 - \mu$ is also a fuzzy gp*-closed set implying that μ is fuzzy gp*-open in fuzzy topological space (Y, τ).

Theorem 4.4. *The intersection of two fuzzy gp*-open sets Δ and ∇ in fuzzy topological space (Y, τ) is also a fuzzy gp*-open set in (Y, τ).*
Proof. Suppose$\Delta \& \nabla$ are two fuzzy gp*-open sets in fuzzy topological space (Y, τ). Which implies $1 - \Delta$ and $1 - \nabla$ are fuzzy gp*-closed in (Y, τ). Now according to theorem 3.9 $(1 - \Delta) \cup (1 - \nabla)$is also a fuzzy gp*-closed in (Y, τ). So $(1 - \Delta) \cup (1 - \nabla) = (1 - (\Delta \cap \nabla))$ is fuzzy gp*-closed in (Y, τ). Implying that $\Delta \cap \nabla$ is also a fuzzy gp*-open set in (Y, τ).

5. Fuzzy gp*-continuous mappings

Definition 5.1. *If G and H are two fuzzy topological spaces then a mapping $g : G \to H$ is called fuzzy gp*-continuous mapping if $g^{-1}(\phi)$ is fuzzy gp*-open set in G, for every fuzzy open ϕ of H.*

Definition 5.2. *If G and H are two fuzzy topological spaces then a mapping $g : G \to H$ is called fuzzy gp*-irresolute mapping if g^{-1} (ϕ) is fuzzy gp*-closed set in G, for every fuzzy gp*-closed set ϕ of H.*

Theorem 5.3. *A function $g : G \to H$ is fuzzy gp*-continuous if & only if the inverse image of each fuzzy closed set in H is fuzzy gp*-closed set in G.*
Proof. Suppose that G and H are two fuzzy topological spaces and $g : G \to H$ be a fuzzy gp*- continuous function. Let α be a fuzzy closed set in H implies that $1 - \alpha$ is a fuzzy open set in H. Now as g is a fuzzy gp*-continuous function implies $g^{-1}(1 - \alpha) = 1 - g^{-1}(\alpha)$ is a fuzzy gp*-open set in G, implying $g^{-1}(\alpha)$ is a fuzzy gp*-closed set in G. Conversely let's suppose that α is a fuzzy closed set in H and $g^{-1}(\alpha)$ is fuzzy gp*-closed in G. Now $1 - \alpha$ is a fuzzy open set in H and $g^{-1}(1 - \alpha) = 1 - g^{-1}(\alpha)$ is fuzzy gp*-open, which was the required proof.

Theorem 5.4. *All fuzzy continuous functions are fuzzy gp*-continuous.*
Proof. Suppose that G and H are two fuzzy topological spaces and $g : G \to H$ be a fuzzy continuous function. Now , suppose α is a fuzzy open set in H & as g is fuzzy continuous function implies $g^{-1}(\alpha)$ is fuzzy open set in G. So by theorem 4.3 $g^{-1}(\alpha)$ is fuzzy gp*-open set in G, implying that $g : G \to H$ is a fuzzy gp*-continuous function.

Theorem 5.5. *All fuzzy g*-continuous functions are fuzzy gp*-continuous function.*
Proof. Let G and H are two fuzzy topological spaces and $g : G \to H$ be a fuzzy g*-continuous function. Now, suppose α is a fuzzy closed set in H & as g is fuzzy g*-continuous function implies $g^{-1}(\alpha)$ is fuzzy generalized star-closed set in G. Now as by theorem 3.4 All fuzzy generalized star pre-closed sets are fuzzy gp* closed implying that $g^{-1}(\alpha)$ is also a fuzzy gp*-closed set, means g is fuzzy gp*-continuous.

Theorem 5.6. *If G, H and I are fuzzy topological spaces and $j : G \to H$ & $k : H \to I$ are such that k is a fuzzy gp*-continuous function and j is fuzzy gp*-irresolute, then koj is a fuzzy gp* continuous function.*
Proof. Suppose α is a fuzzy closed set in I. Also $(koj)^{-1}(\alpha) = j^{-1}(k^{-1}(\alpha))$. Now as k is fuzzy gp*-continuous, so by its definition $A = k^{-1}(\alpha)$ is a fuzzy gp*-closed set in H. Now as j is a fuzzy gp*-irresolute implies $j^{-1}(A) = j^{-1}(k^{-1}(\alpha))$ is also fuzzy gp*-closed set in G, implying that koj is a fuzzy gp* continuous function.

Theorem 5.7. *Suppose $j : G \to H$ & $k : H \to I$ are such that k is a fuzzy continuous function and j is fuzzy gp*-continuous, then koj is a fuzzy gp* continuous function.*

Proof. Suppose $\alpha \leq I$ be any fuzzy closed set in I. Also $(koj)^{-1}(\alpha) = j^{-1}(k^{-1}(\alpha))$. Now as k is a fuzzy continuous function, implies $A = k^{-1}(\alpha)$ is a fuzzy closed set in H. Now j is a fuzzy gp*-continuous function, implying that $j^{-1}(A) = j^{-1}(k^{-1}(\alpha))$ is a fuzzy gp*-closed set in G. Which shows that koj is a fuzzy gp*-continuous function by theorem 5.3.

Theorem 5.8. *Suppose $j : G \to H$ & $k : H \to I$ are fuzzy gp*-irresolute functions, then koj is a also fuzzy gp*-irresolute function.*

Proof. Let $\alpha \leq I$ be any fuzzy gp*- closed set in I. Also $(koj)^{-1}(\alpha) = j^{-1}(k^{-1}(\alpha))$. Now as k is a fuzzy gp*-irresolute function, implies $A = k^{-1}(\alpha)$ is a fuzzy gp*-closed set in H. Now as j is also fuzzy gp*-irresolute, implying that $j^{-1}(A) = j^{-1}(k^{-1}(\alpha))$ is a fuzzy gp*-closed set in G. So by definition 5.2 koj is also a fuzzy gp*-irresolute function.

6. Fuzzy gp*-connectedness

Definition 6.1. *A fuzzy gp*-connected space is a fuzzy topological space (Y, τ) that cannot be written as the union of two non-empty disjoint fuzzy gp*-open sets in (Y, τ).*

Theorem 6.2. *If (Y, τ) is a fts, then the following are equivalent;*
(a) Y is a fuzzy gp*-connected space.
(b) The only subsets in Y which are both fuzzy gp*-open and fuzzy gp*-closed are 0_Y & 1_Y.

Proof. (a) $\Rightarrow$ (b): Let Y is a fuzzy gp*-connected space. Now, suppose $\alpha < Y$ is both fuzzy gp*-open & fuzzy gp*-closed. Then $1 - \alpha$ is also both fuzzy gp*-closed & fuzzy gp*-open. So $Y = \alpha \vee (1 - \alpha)$ is the union of two disjoint non empty fuzzy gp*-open sets, which contradicts (a). Implying $\alpha = 0_Y$ or $\alpha = 1_y$.
(b) $\Rightarrow$ (a): Suppose α & β are non-empty disjoint fuzzy gp*-open sets such that $Y = \alpha \vee \beta$. Now $\alpha = 1 - \beta$ & $\beta = 1 - \alpha$ are fuzzy gp*-open sets, which in turn implies α & β are also fuzzy gp*-closed sets. Now by (b) $\alpha = 0_Y$ or $\alpha = 1_Y$ implies Y is fuzzy gp*-connected.

Theorem 6.3. *All fuzzy gp*-connected spaces are fuzzy connected spaces.*

Proof. Let Y is a fuzzy gp*-connected space and suppose that Y is not a connected space. Then by Definition 2.12 there exists a non-empty proper fuzzy clopen subset λ in Y. Now as every fuzzy closed set is fuzzy gp*-closed implying that λ is also a non-empty proper subset of Y, which is both fuzzy gp*-closed and fuzzy gp*-open in Y. So by Theorem 6.2 Y is not a fuzzy gp*-connected space, which is a contradiction implying that Y is a connected space.

Theorem 6.4. *Suppose $g : G \to H$ is an onto fuzzy gp*-continuous map and G is a fuzzy gp*-connected space then H is also a fuzzy connected space.*
Proof. Let's suppose that H is not a fuzzy connected space and suppose that $H = M \vee N$, where M & N are disjoint fuzzy non-empty open sets in H. Since g is fuzzy gp*-continuous implies $g^{-}(M)$ & $g^{-}(N)$ are non-empty disjoint fuzzy gp*-open sets in G and as g is onto also implies $G = g^{-1}(M) \vee g^{-1}(N)$, which contradicts fuzzy gp*-connectedness of G. So H is a fuzzy connected space.

Theorem 6.5. *Suppose $g : G \to H$ is an onto fuzzy gp*-irresolute map and G is fuzzy gp*-connected space then H is also a fuzzy gp*- connected space.*
Proof. Let's suppose that H is not a fuzzy gp*-connected space and let's suppose that $H = M \vee N$ where M & N are non-empty fuzzy disjoint gp*-open sets in H. Now, as g is fuzzy gp*-irresolute function implies $g^{-1}(M)$ & $g^{-1}(N)$ are non-empty disjoint fuzzy gp*-open sets in G and as g is onto also implies $G = g^{-1}(M) \vee g^{-1}(N)$, which contradicts fuzzy gp*-connectedness of G. Implies H is a fuzzy connected space.

7. Fuzzy T*gp-Space

Definition 7.1. *A fts (Y, τ) is called a fuzzy T*gp-space if every fuzzy gp*-closed set in (Y, τ) is a fuzzy closed set in (Y, τ).*

Theorem 7.2. *Every fuzzy T*gp-space is fuzzy T*p-space.*
Proof. Let Y be a fuzzy T*gp-space. Let A be a fuzzy g*p-closed set in Y. Now by Theorem 3.4 as every fuzzy g*p-closed set is fuzzy gp*-closed set, implies A is fuzzy gp*-closed set in Y. Since Y is a fuzzy T*gp-space, A is a fuzzy closed set in Y. Hence Y is a fuzzy T*p-space.

Theorem 7.3. *Every fuzzy T*gp-space is fuzzy $T^*_{1/2}$ space.*
Proof. Let Y be a fuzzy T*gp-space. Let A be a fuzzy g*-closed set in Y. Now by Theorem 3.6, A is fuzzy gp*-closed set in Y. Since Y is a fuzzy-T*gp-space implies A is fuzzy closed set in Y. Hence Y is a $T^*_{1/2}$ space.

Theorem 7.4. *If G is a fuzzy T*gp-space then G is fuzzy connected iff it is fuzzy gp*-connected.*
Proof. Let G is a fuzzy connected space & suppose that G is not fuzzy gp*-connected. Then there exists two proper fuzzy gp*-open sets M & N of G such that $G = M \vee N$ & $M \wedge N = \phi$, which implies $M = 1 - N$ & $N = 1 - M$ are also fuzzy gp*-closed sets and G is a fuzzy T*gp-space implies M & N are fuzzy

closed sets (by Definition 7.1). So $M = 1 - N$ & $N = 1 - M$ implies M & N are fuzzy open sets & $G = M \vee N$, $M \wedge N = \phi$ contradicts the fuzzy connectedness of G. So G is a fuzzy gp*-connected space. Conversely suppose that G is fuzzy gp*-connected and let G is not fuzzy connected implies there exists two proper fuzzy open subsets M & N of G such that $G = M \vee N$ & $M \wedge N = \phi$. Now, as every fuzzy open set is fuzzy gp*-open, so $G = M \vee N$ contradicts the fuzzy gp*-connectedness of G. Implies G is a fuzzy connected space.

References

[1] L. A. Zadeh, On Fuzzy Sets, Information and control 8(1965), 338-353.

[2] C. L. Chang, On Fuzzy Topological spaces, Journal of mathematical analysis and applications, 24(1968),182-190.

[3] S. S. Benchalli and G. P. Siddapur, On Fuzzy g* Pre-Continuous Maps in Fuzzy Topological Spaces, International Journal of Computer Applications, volume 16. No.2, February 2011.

[4] H. R. Moradi, A Kamali, On fuzzy strongly g*-closed sets and g**-closed sets, Int. J. Adv. Appl. Math and Mech. 2(4)(2015), 13-17.

[5] Bin Shanna, A. S., On fuzzy strongly semi continuity and fuzzy pre continuity, Fuzzy sets and systems, 4(11)(1991), 330-338.

[6] S. S. Thakur and Manoj Mishra, On fuzzy g*-closed sets, International journal of theoretical and Applied Sciences, 2(2)(2010), 28-29.

[7] Thakur S. S., R. Malviya, Generalized closed sets in fuzzy topology, Math Notae, 38(1995), 137-140.

[8] T. Fukutake, R. K. Saraf, M. Caldas and S. Mishra, Mappings via Fgp-closed sets, Bull. of Fukuoka Univ. of Edu. Vol. 52(2003) Part III, 11-20.

[9] N. Levine, Generalized closed sets in topology, Rend. Circ. Mat. Palermo 19(2)(1970), 89-96.

[10] U. V. Fatteh, D. S. Bassan, Fuzzy connectedness and its stronger forms, J. Math. Anal. Appl., 111(1985), 449-464.