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ON SOME OF OPEN SETS IN FUZZY TOPOLOGY

M. JEYARAMAN[1], S. VIJAYALAKSHMI[2*] , O. RAVI[3], R. MUTHURAJ[4]

[1]PG and Research Department of Mathematics, Raja Dorai Singam Govt. Arts College,Sivagangai.

[2]Department of Mathematics, St. Michael College of Enggineering & Technology, Kalayarkovil

[3]Department of Mathematics, P. M. Thevar College, Usilampatti

[4]PG and Research Department of Mathematics, H. H. The Rajah's College,pudukottai

S. VIJAYALAKSHMI

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ABSTRACT

In this paper, we offer a new class of sets called fuzzy $\ddot{g}$-open sets in fuzzy topological spaces and we study some of its basic properties. It turns out that this class lies between the class of fuzzy open sets and the class of fuzzy g-open sets.

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Key words and Phrases: Fuzzy Topological space, f$\ddot{g}$-open set, f$\ddot{g}_{\alpha}$-open set, fαgs-open, fω-open set.

INTRODUCTION

The study of fuzzy sets was initiated with the famous paper of Zadeh [22] and thereafter Chang [7] paved the way for subsequent tremendous growth of the numerous fuzzy topological concepts. The theory of fuzzy topological spaces was developed by several authors by considering the basic concepts of general topology. The extensions of functions in fuzzy settings can be carried out using the concepts of quasi coincidences and q-neighborhoods by Pu and Liu [14]. Generalized fuzzy open sets and regular generalized fuzzy open sets were defined in [16, 14].

In this paper, we introduce a new class of sets namely fuzzy $\ddot{g}$-open (briefly f$\ddot{g}$-open) sets in fuzzy topological spaces. This class lies between the class of fuzzy open sets and the class of fg-open sets. This class also lies between the class of fuzzy open sets and the class of fω-open sets.

2. PRELIMINARIES

Throughout this paper (X, τ) and (Y, σ) (or X and Y) represent fuzzy topological spaces on which no separation axioms are assumed unless otherwise mentioned. For a subset A of a fuzzy space (X, τ), cl(A), int(A) and A^c denote the closure of A, the interior of A and the complement of A respectively.

We recall the following definitions which are useful in the sequel

Definition 2.1: A subset A of a space (X, τ) is called:

(i) Fuzzy semi-open set [3] (briefly fs-open) if A $\leq$ cl(int(A)).

(ii) Fuzzy preopen set [6] (briefly fp-open) if A $\leq$ int(cl(A)).

(iii) Fuzzy α -open set [6] (briefly f α -open) if A $\leq$ int(cl(int(A))).

(iv) Fuzzy β-open set [21](briefly f β -open) if A $\leq$ cl(int(cl(A))).

(v) Fuzzy regular open set [3] if A = int(cl(A)).

The complements of the above mentioned fuzzy open sets are called their respective closed sets. The semi closure (resp. α -closure, semi-pre-closure) of a subset A of X, denoted by scl(A) (resp. α cl(A), spcl(A)) is defined to be the intersection of all fuzzy semi-closed (resp. fuzzy α -closed, fuzzy semi-preclosed) sets of (X, τ) containing A. It is known that scl(A) (resp. α cl(A), spcl(A)) is a fuzzy semi-closed (resp. fuzzy α -closed, fuzzy semi-pre closed) set.

Definition 2.2: A subset A of a space (X,τ) is called:

(i) a fuzzy generalized closed (briefly fg-closed) set [4] if cl(A) $\leq$ U whenever A $\leq$U and U is fuzzy open in (X, τ). The complement of fg-closed set is called fg-open set.

(ii) a fuzzy semi-generalized closed (briefly fsg-closed) set [5] if scl(A) $\leq$ U
whenever A $\leq$ U and U is fuzzy semi-open in (X, τ). The complement of fsg-closed set is called fsg-open set.

(iii) a fuzzy generalized semi-closed (briefly fgs-closed) set [18] if scl(A) $\leq$ U
whenever A $\leq$ U and U is fuzzy open in (X, τ). The complement of fgs-closed set is called fgs-open set.

(iv) a fuzzy α -generalized closed (briefly f α g-closed) set [16] if α cl(A) $\leq$ U whenever
A $\leq$ U and U is fuzzy open in (X, τ). The complement of f α g-closed set is called
f α g-open set.

(v) a fuzzy generalized semi-preclosed (briefly fgsp-closed) set [18] if spcl(A) $\leq$ U whenever A $\leq$ U and U is fuzzy open in (X, τ). The complement of fgsp-closed set is called fgsp-open set.

(vi) a f ω -closed set [20] if cl(A) $\leq$ U whenever A $\leq$ U and U is fuzzy semi-open in (X, τ). The complement of f ω -closed set is called f ω -open set.

(vii) a fuzzy $\ddot{g}$ -closed set (briefly f $\ddot{g}$ -closed set) [10]if cl(A) ≤ U whenever A ≤ U and U is fsg-open in (X, τ).

(viii) a fuzzy $\ddot{g}_{\alpha}$ -closed set (briefly f $\ddot{g}_{\alpha}$ -closed set)[10] if α cl(A) $\leq$ U whenever A $\leq$ U and U is fsg-open in (X, τ). The complement of f $\ddot{g}_{\alpha}$ -closed set is called f $\ddot{g}_{\alpha}$ -open set.

(ix) a fuzzy ψ -closed set (briefly f ψ -closed set) [10]if scl(A) $\leq$ U whenever A $\leq$ U and U is fsg-open in (X, τ). The complement of f ψ -closed set is called f ψ -open set.

(x) a f αgs -closed set (briefly f αgs --closed set)[10] if α cl(A) $\leq$ U whenever A $\leq$ U and U is fuzzy semi-open in (X, τ). The complement of f αgs -closed set is called f αgs -open set.

Remark 2.3: The collection of all **f** $\ddot{g}$ -closed (resp. f ω -closed, fg-closed, fgs-closed, fgsp-closed, f α g-closed, fsg-closed, f α -closed, fuzzy semi-closed) sets is denoted by F $\ddot{G}$ C(X) (resp. F ω C(X), F G C(X), F GS C(X), F GSP C(X), F αg C(X), F SG C(X), F α C(X), F S C(X)).

The collection of all **f** $\ddot{g}$ -open (resp. f ω -open, fg-open, fgs-open, fgsp-open, f α g-open, fsg-open, f α -open, fuzzy semi-open) sets is denoted by F $\ddot{G}$ O(X) (resp. FωO(X), F G O(X), F GS O(X), F GSP O(X), FαGO(X), F SG O(X), F α O(X), F S O(X)).

We denote the power set of X by P(X).

Theorem 2.4[10]: If A and B are f $\ddot{g}$ -closed sets in (X, τ), then A $\vee$ B is f $\ddot{g}$ -closed in (X, τ).

Theorem 2.5[10]: If A is f $\ddot{g}$ -closed in (X, τ) and A $\leq$ B $\leq$ cl(A), then B is f $\ddot{g}$ -closed in (X, τ).

3. FUZZY $\ddot{g}$ -OPEN SETS

We introduce the following definition.

Definition 3.1: A fuzzy set A in a fuzzy topological space is called fuzzy $\ddot{g}$ -open set (briefly f $\ddot{g}$ -open set) if A^c is fuzzy $\ddot{g}$ -closed.

Proposition 3.2: Every fuzzy open set is f $\ddot{g}$ -open.

Proof: If A is any fuzzy open set in (X, τ). Then A^c is fuzzy closed set and G is any fsg-open set such that $G \geq A^c = cl(A^c)$. Thus A^c is f $\ddot{g}$ -closed. Hence A is f $\ddot{g}$ -open set.

The converse of Proposition 3.2 need not be true as seen from the following example.

Example 3.3: Let X = {a, b} and $\alpha : X \longrightarrow [0,1]$ be defined by α (a) = α (b) = 0.5 and β(a) = β(b) = 0.6. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, β, 1_x}. In (X, τ), the fuzzy subset λ = (0.7, 0.7) is f $\ddot{g}$ -open set in (X, τ) but not fuzzy open in (X, τ).

Proposition 3.4: Every f $\ddot{g}$ -open set is fgsp-open.

Proof: If A is any fuzzy open set in (X, τ). Then A^c is a f $\ddot{g}$ -closed subset of (X, τ) and G is any fuzzy open set such that $G \geq A^c$, every fuzzy open set is fsg-open, we have

$G \geq cl(A^c) \geq spcl(A^c)$. Thus A^c is fgsp-closed. Hence A is fgsp-open in (X, τ).

The converse of Proposition 3.4 need not be true as seen from the following example.

Example 3.5: Let X = {a, b} and $\alpha : X \longrightarrow [0, 1]$ be defined by α (a) = α (b) = 0.5. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (0.6, 0.6) is fgsp-open set but not f $\ddot{g}$ -open set in (X, τ).

Proposition 3.6: Every f $\ddot{g}$ -open set is f ω -open.

Proof: Suppose that $A^c \leq G$ and G is fuzzy semi-open in (X, τ). Since every fuzzy semi-open set is fsg-open and A^c is f $\ddot{g}$ -closed, therefore $cl(A^c) \leq G$. Thus A^c is f ω -closed in (X, τ). Hence A is f ω -open.

The converse of Proposition 3.6 need not be true as seen from the following example.

Example 3.7: Let X = {a, b} and $\alpha : X \longrightarrow [0,1]$ be defined by α (a) = α (b) = 0.5. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (0.6, 0.6) is f ω -open but not f $\ddot{g}$ -open set in (X, τ).

Proposition 3.8: Every f $\ddot{g}$ -open set is fg-open.

Proof: If A is a f $\ddot{g}$ -open subset of (X, τ). Then A^c is a f $\ddot{g}$ -closed subset of (X, τ) and G is any fuzzy open set such that $G \geq A^c$, since every fuzzy open set is fsg-open, we have

$G \geq cl(A^c)$. Thus A^c is fg-closed in (X, τ). Hence A is fg-open.

The converse of Proposition 3.8 need not be true as seen from the following example.

Example 3.9: Let X = {a, b} and $\alpha : X \longrightarrow [0,1]$ be defined by α (a) = α (b) = 0.5 . Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (0.6, 0.6) is fg-open but not f $\ddot{g}$ -open set in (X, τ).

Proposition 3.10: Every f $\ddot{g}$ -open set is f α g-open.

Proof: If A is a f $\ddot{g}$ -open subset of (X, τ), A^c is a f $\ddot{g}$ -closed subset of (X, τ) and G is any fuzzy open set such that $G \geq A^c$, since every fuzzy open set is fsg-open, we have $G \geq cl(A^c) \geq \alpha\, cl(A^c)$. Thus A^c is f α g-closed in (X, τ). Hence A is f α g-open.

The converse of Proposition 3.10 need not be true as seen from the following example.

Example 3.11:

Let X = {a, b} and $\alpha : X \longrightarrow [0,1]$ be defined by α (a) = 1 α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (1, 0.5) is f α g-open set but not f $\ddot{g}$ -open set in (X, τ).

Proposition 3.12: Every f $\ddot{g}$ -open set is fgs-open.

Proof: If A is a f$\ddot{g}$-open subset of (X, τ), A^c is a f$\ddot{g}$-closed subset of (X, τ) and G is any fuzzy open set such that G $\geq$ A^c, since every fuzzy open set is fsg-open,
we have G $\geq$ cl(A^c) $\geq$ scl(A^c). Thus A^c is fgs-closed set in (X, τ). Hence A is fgs-open.
The converse of Proposition 3.12 need not be true as seen from the following example.

Example 3.13: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = 1, α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (1, 0.5) is fgs-open set but not f$\ddot{g}$-open set in (X, τ).

Proposition 3.14: Every f$\ddot{g}$-open set is f$\ddot{g}_\alpha$-open.

Proof: If A is a f$\ddot{g}$-open subset of (X, τ). Then A^c is f$\ddot{g}$-closed subset of (X, τ) and G is any fsg-open set such that G $\geq$ A^c, then G $\geq$ cl(A^c) $\geq$ α cl(A^c). $\therefore$ A^c is f$\ddot{g}_\alpha$-open in
(X, τ). Hence A is f$\ddot{g}_\alpha$-open.The converse of Proposition 3.15 need not be true as seen from the following example.

Example 3.15: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = 1, α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α,1_x}. In (X, τ), the fuzzy subset λ = (1, 0.5) is f$\ddot{g}_\alpha$-open set in (X, τ) but not f$\ddot{g}$- open in (X, τ).

Proposition 3.16: Every fα-open set is f$\ddot{g}_\alpha$-open.

Proof : If A is a fα-open subset of (X, τ). Then A^c is fα-closed subset of (X, τ) and G is any fsg-open set such that G $\geq$ A^c, then G $\geq$ cl(A^c) $\geq$ α cl(A^c). Thus A^c is f$\ddot{g}_\alpha$-closed. Hence A is f$\ddot{g}_\alpha$-closed.
The converse of Proposition 3.17 need not be true as seen from the following example

Example 3.17: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = 1, α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (0.5, 1) is f$\ddot{g}_\alpha$-open but not fα-open set in (X, τ).

Proposition 3.18: Every f$\ddot{g}$-open set is fψ-open.

Proof: If A is a f$\ddot{g}$-open subset of (X, τ). Then A^c is a f$\ddot{g}$-closed subset of (X, τ) and G is any fsg-open set such that G $\geq$ A^c, then G $\geq$ cl(A^c) $\geq$ scl(A^c). Thus A^c is fψ-closed in (X, τ). Hence A is fψ-open.The converse of Proposition 3.20 need not be true as seen from the following example.

Example 3.19: Let X = {a, b} and α : X $\longrightarrow$ [0, 1] be defined by α (a) = 1, α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (1, 0.5) is fψ-open set but not f$\ddot{g}$-open set in (X, τ).

Proposition 3.20: Every fψ-open set is fsg-open.

Proof: If A is a fψ-open subset of (X, τ). Then A^c is a fψ-closed. Suppose that A^c $\leq$ G and G is fuzzy semi-open in (X, τ). Since every fuzzy semi-open set is fsg-open and A^c is
fψ-closed, therefore scl(A^c) $\leq$ G. Thus A^c is fsg-closed in (X, τ). Hence A is fsg-open.
The converse of Proposition 3.22 need not be true as seen from the following example.

Example 3.21: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = α(b) = 0.5. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset β= (0.6, 0.6) is fsg-open set but not fψ-open set in (X, τ).

Proposition 3.22: Every fs-open set is fψ-open.

Proof:f A is fs-open set in (X, τ). Then A^c is fs-closed set in (X, τ) and G is any fuzzy semi-open set such that G $\geq$ A^c, since every fuzzy semi-open set is fsg-open, we have
G $\geq$ A^c = scl(A^c). Thus A^c is fψ-closed in (X, τ). Hence A is fψ-open in (X, τ).
The converse of Proposition 3.23 need not be true as seen from the following example.

Example 3.23: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α(a) = α(b) = 0.5. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset λ = (0.4, 0.4) is fψ -open set but not fs-open set in (X, τ).

Proposition 3.24: Every fω-open set is fαgs -open.

Proof: If A is a fω-open subset of (X, τ). Then A^c is a fω-closed subset of (X, τ) and G is any fuzzy semi-open set such that G $\geq$ A^c, then G $\geq$ cl(A^c) $\geq$ α cl(A^c). Thus A^c is fαgs -closed set. Hence A is fαgs -open set

The converse of Proposition 3.26 need not be true as seen from the following example.

Example 3.25: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = 1, α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset β = (1, 0.5) is fαgs -open but not fω-open set in (X, τ).

Proposition 3.26: Every f$\ddot{g}$ -open set is fαgs -open.

Proof: If A is a f$\ddot{g}$ -open subset of (X, τ). Then A^c is a f$\ddot{g}$ -closed subset of (X, τ) and G is any fuzzy semi-open set such that G $\geq$ A^c, since every fuzzy semi-open set is fsg-open, we have G $\geq$ cl(A^c) $\geq$ α cl(A^c). Thus A^c is fαgs -closed. Hence A is fαgs -open in (X, τ).

The converse of Proposition 3.28 need not be true as seen from the following example.

Example 3.27: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = 1, α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset β = (1, 0.5) is fαgs -open but not f$\ddot{g}$ -open set in (X, τ).

Proposition 3.28: Every fαgs -open set is fα g-open.

Proof: If A is a fαgs -open sub set of (X, τ). Then A^c is a fαgs -closed sub set of (X, τ).

Suppose that A^c $\leq$ G and G is fuzzy semi-open such that G $\geq$ A^c. Since every fuzzy semi-open set is fsg-open, we have G $\geq$ cl(A^c) $\geq$ αcl(A^c). Thus A^c is fα g-closed in (X, τ). Hence A is fα g-open in (X, τ).

The converse of Proposition 3.30 need not be true as seen from the following example.

Example 3.29: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) =α (b) = 0.5 . Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset β = (0.6, 0.6) is fα g -open set but not fαgs -open set in (X, τ).

Proposition 3.30: Every fω-open set is fg-open.

Proof: If A is a fω-open sub set of (X, τ). Then A^c is a fω-closed sub set of (X, τ). Suppose that A^c $\leq$ G and G is fuzzy open set such that G $\geq$ A^c. Since every fuzzy open set is fuzzy semi open set, we have G $\geq$ cl(A^c). Thus A^c is fg-closed. Hence A is fg-open set in (X, τ).

The converse of Proposition 3.32 need not be true as seen from the following example.

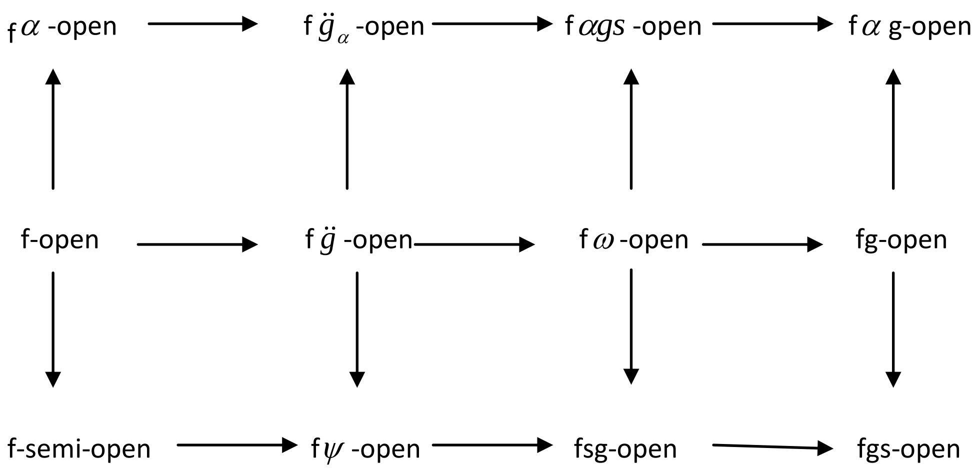
Example 3.31: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = 1, α (b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ), the fuzzy subset β = (0, 0.5) is fg-open but not fω-open set in (X, τ).

Remark 3.32: The following examples show that f$\ddot{g}$ -open sets are independent of fα -open sets and fuzzy semi-open sets.

Example 3.33: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = α (b) = 0.5 and β (a) =β (b) =0.6. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, β , 1_x}. In (X, τ), the fuzzy subset λ = (0.6, 0.6)is f$\ddot{g}$ -open but it is neither fα -open nor fuzzy semi-open in (X, τ).

Example 3.34: Let X = {a, b} and α : X $\longrightarrow$ [0,1] be defined by α (a) = 1, α(b) = 0. Then (X, τ) is a fuzzy topological space with τ = {0_x, α, 1_x}. In (X, τ) the fuzzy subset β = (1, 0.5) is fα -open as well as fuzzy semi-open in (X, τ) but it is not f$\ddot{g}$ -open in (X, τ).

Remark 3.35:we obtain the following diagram, where A $\rightarrow$ B (resp. A $\longleftrightarrow$ B) represents A implies B but not conversely (resp. A and B are independent of each other).



4.0 PROPERTIES OF f$\ddot{g}$ -OPEN SETS

In this section, we discuss some basic properties of f$\ddot{g}$ -open sets.

Theorem 4.1: If A and B are f$\ddot{g}$ -open sets in (X, τ), then A $\wedge$ B is f$\ddot{g}$ -open in (X, τ).

Proof: Considering the compliments in theorem 2.4, the proof follows.

Remark 4.2: The union of two f$\ddot{g}$ -open sets in (X, τ) is not necessarily f$\ddot{g}$ -open as seen from the following example.

Example 4.3: Let X = {a, b} and α , β : X $\longrightarrow$ [0,1] be defined by α (a) = 0.6, α (b) = 0 and β (a) = 0, β (b) =0.3. Then (X, τ) is a fts with τ = {0_x, α, β , α v β 1_x}. In (X, τ), the fuzzy subset λ_1 = (0.7, 0) and λ_2 = (0, 0.3) are f$\ddot{g}$ -open, but $\lambda_1 \vee \lambda_2$ = (0.7, 0.3) is not f$\ddot{g}$ -open.

Theorem 4.4:A fuzzy subset A of a fts (X, τ) is f$\ddot{g}$ -open iff F ≤ int(A) whenever 1-F is fsg-open and F ≤ A.

Proof: Necessity: Assume that A is f$\ddot{g}$ -open in (X, τ). Let 1-F be fsg-open such that F ≤ A. Then 1-A ≤ 1-F where 1-A is f$\ddot{g}$ -closed. Hence cl(1-A) ≤ 1-F and F ≤ 1-cl(1-A) = int(A).

Sufficiency: To prove that A is f$\ddot{g}$ -open under the given conditions, we prove 1-A is f$\ddot{g}$ -closed in (X, τ). Let U be any fsg-open set such that 1-A ≤ U. Then 1-U ≤ A.
Taking F = 1-U, we have F ≤ A where 1-F is fsg-open. By assumption F ≤ int(A) which implies 1-U ≤ int(A) and hence 1-int(A) ≤ U. Thus cl(1-A) ≤ U which proves that 1-A is
f$\ddot{g}$ -closed and A is f$\ddot{g}$ -open.

Theorem 4.5: If A is f$\ddot{g}$ -open in (X, τ) and int(A) $\leq$ B $\leq$ (A), then B is f$\ddot{g}$ -open in (X, τ).

Proof: Let int(A) $\leq$ B $\leq$ (A) implies 1-A $\leq$ 1-B $\leq$ 1-int(A) = cl(1-A) where 1-A is f$\ddot{g}$ -closed in (X, τ). By Theorem 4.3, 1-B is f$\ddot{g}$ -closed and hence B is f$\ddot{g}$ -open in (X, τ).

Proposition 4.6: If A is a fsg-open and f$\ddot{g}$ -closed in (X, τ), then A is fuzzy closed in (X, τ).

Proof: Since A is fsg-open and f$\ddot{g}$ -closed, cl(A) $\leq$ A and hence A is fuzzy closed in (X, τ).

REFERENCES

[1]. K. M. Abd El- Hakeim, Generalized semi-continuious mappings in fuzzy topological spaces, J. Fuzzy Math., 7(3) (1999), 577-589.

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

[3]. K. K. Azad, On fuzzy semi continuity, fuzzy almost continuity and fuzzy weakly continuity, J. Math. Anal., 82(1) (1981), 14-32.

[4]. G. Balasubramanian and P. Sundram, On some generalizations of fuzzy continuious functions, Fuzzy sets and Systems, 86(1) (1997), 93-100.

[5]. G. Balasubramanian, On Fuzzy pre separation-axioms, Bull Calcutta Math. Soc., 90(6) (1998), 427-434.

[6]. A. S. Bin Shahna, On fuzzy strong semi continuity and fuzzy pre continuity, Fuzzy sets and systems, 44(2) (1991), 303-308.
[7]. C. L. Chang, Fuzzy topological spaces, Jour. Math. Anal. Appl., 24(1968), 182-190.
[8]. S. G.Crossley, and S. K. Hildebrand, Semi-closure, Texas J. Sci, 22(1971), 99-112.
[9]. M. E. EL-Shafei and A. Zakari, Semi-generalized continuous mappings in fuzzy topological spaces, J. Egypt Math. Soc., 15(1) (2007), 57-67.
[10]. M. Jeyaraman, S. Vijayalakshmi, and O. Ravi, New notions of closed sets in Fuzzy topology International journal of mathematical archive-4(8), (2013-14). 1-7.
[11]. O. Njastad, On some classes of nearly open sets, Pacific J. Math., 15(1965),961-970.
[12]. T. Noiri, H. Maki and J. Umehara, Generalized preclosed functions, Mem. Fac. Sci. Kochi Univ. Math., 19(1998), 13-20.
[13]. J. H. Park and J. K. Park, On regular generalized fuzzy closed sets and generalizations of fuzzy continuous functions, Indian J. Pure Appl. Math., 34(7)(2003), 1013-1024.
[14]. P. M. Pu and Y. M. Liu, Fuzzy topology I, Neighbourhood structure of a fuzzy point and Moore-Smith Convergence, Jour. Math. Anal. Appl., 76(1980), 571-599.
[15]. R. Prasad, S. S. Thakur and R. K. Saraf, Fuzzy α –irresolute mappings, J. Fuzzy Math., 2(2) (1994), 335-339.
[16]. R. K. Saraf, M. Caldas and S. Mishra, Results via Fgα-closed sets and Fα g-closed sets, preprint.
[17]. R. K. Saraf, Govindappa Navalagi, and Meena Khanna, On Fuzzy Semi- Pre-Gereralized Closed Sets, Bull. Math. Soc., (2)28(1)(2005), 19-30.
[18]. R. K. Saraf and M. Khana, Fuzzy generalized semi preclosed sets, J. Tripura Math. Soc., 3(2001), 59-68.
[19]. M. Sudha, E. Roja, and M. K. Uma, Slightly fuzzy ω-continous mappings, Int. Journal of Math Analysis, 5(16)(2011), 779-787.
[20]. S. S. Thakur and S. Singh, On fuzzy semi pre-open sets and fuzzy semi pre continuity, Fuzzy sets and systems, 98(3) (1998), 383-391.
[21]. T. H. Yalvac„ Semi-interior and Semi closure of a fuzzy set, J. Math. Anal. Appl., (132)(2) (1998), 356-364.
[22]. L. A. Zadeh, Fuzzy sets, Information and Control, 8(1965), 338-353.