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HOMOMORPHISM IN Q-INTUITIONISTIC L-FUZZY SUBNEARRINGS OF A NEARRING

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ABSTRACT

In this paper, we study some of the properties of Q-intuitionistic L-fuzzy subnearring of a nearring and prove some results on these.

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KEYWORDS: *(Q, L)-fuzzy subset, Q-intuitionistic L-fuzzy subset, Q-intuitionistic L-fuzzy subnearring, Q-intuitionistic L-fuzzy normal subnearring.*

INTRODUCTION

After the introdution of fuzzy sets by L. A. Zadeh [15], several researchers explored on the generalization of the notion of fuzzy set. The concept of intuitionistic L-fuzzy subset was introduced by K. T. Atanassov [4, 5], as a generalization of the notion of fuzzy set. Azriel Rosenfeld [6] defined fuzzy groups. Asok Kumer Ray [3] defined a product of fuzzy subgroups and A.Solairaju and R.Nagarajan[13,14] have introduced and defined a new algebraic structure called Q-fuzzy subgroups. We introduce the concept of Q-intuitionistic L-fuzzy subnearring of a nearring and established some results.

1. PRELIMINARIES:

1.1 Definition: Let X be a non-empty set and L = (L, $\leq$) be a lattice with least element 0 and greatest element 1 and Q be a non-empty set. A **(Q, L)-fuzzy subset** A of X is a function A: XxQ $\rightarrow$ L.

1.2 Definition: Let (L, $\leq$) be a complete lattice with an involutive order reversing operation N: L $\rightarrow$ L and Q be a non-empty set. A **Q-intuitionistic L-fuzzy subset** (QILFS) A in X is defined as an object of the form A={< (x, q), μ_A(x, q), ν_A(x, q) > / x in X and q in Q }, where μ_A : XxQ $\rightarrow$ L and ν_A : XxQ $\rightarrow$ L define the degree of membership and the degree of non-membership of the element x$\in$X respectively and for every x$\in$X satisfying $\mu_A(x) \leq N(\nu_A(x))$.

1.3 Definition: Let (R, +, .) be a nearring. A Q-intuitionistic L-fuzzy subset A of R is said to be a Q-intuitionistic L-fuzzy subnearring(QILFSNR) of R if it satisfies the following axioms:

(i) $\mu_A(x-y, q) \geq \mu_A(x, q) \wedge \mu_A(y, q)$
(ii) $\mu_A(xy, q) \geq \mu_A(x, q) \wedge \mu_A(y, q)$
(iii) $\nu_A(x-y, q) \leq \nu_A(x, q) \vee \nu_A(y, q)$
(iv) $\nu_A(xy, q) \leq \nu_A(x, q) \vee \nu_A(y, q)$, for all x and y in R and q in Q.

1.4 Definition: Let X and X′ be any two sets. Let f: X $\rightarrow$ X′ be any function and A be a Q-intuitionistic L-fuzzy subset in X, V be a Q-intuitionistic L-fuzzy subset in f(X) = X′, defined by $\mu_V(y, q) = \sup_{x\in f^{-1}(y)} \mu_A(x, q)$ and $\nu_V(y, q) = \inf_{x\in f^{-1}(y)} \nu_A(x, q)$, for all x in X and y in X′. A is called a preimage of V under f and is denoted by $f^{-1}(V)$.

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1.5 Definition: Let (R, +, .) be a nearring. A Q-intuitionistic L-fuzzy subnearring A of R is said to be a Q-intuitionistic L-fuzzy normal subnearring(QILFNSNR) of R if

(i) $\mu_A(x+y, q) = \mu_A(y+x, q)$ and $\nu_A(x+y, q) = \nu_A(y+x, q)$, for all x and y in R and q in Q.
(ii) $\mu_A(xy, q) = \mu_A(yx, q)$ and $\nu_A(xy, q) = \nu_A(yx, q)$, for all x and y in R and q in Q.

2. SOME PROPERTIES OF Q-INTUITIONISTIC L-FUZZY SUBNEARRINGS OF A NEARRING:

2.1 Theorem: Let (R, +, .) and (R^I, +, .) be any two nearrings. The homomorphic image of a Q-intuitionistic L-fuzzy subnearring of R is a Q-intuitionistic L-fuzzy subnearring of $f(R) = R^I$.

Proof: Let (R, +, .) and (R^I, +, .) be any two nearrings Q be a non-empty set. Let f: $R \to R^I$ be a homomorphism. Then $f(x+y) = f(x) + f(y)$ and $f(xy) = f(x) f(y)$, for all x and y in R. Let A be a Q-intuitionistic L-fuzzy subnearring of R. We have to prove that V is a Q-intuitionistic L-fuzzy subnearring of f (R) = R^I.

Now, for f(x), f(y) in R^I and q in Q, $\mu_v(f(x) - f(y), q) = \mu_v(f(x - y), q) \geq \mu_A(x - y, q) \geq \mu_A(x, q) \wedge \mu_A(y, q)$, which implies that $\mu_v(f(x) - f(y) ,q) \geq \mu_v(f(x), q) \wedge \mu_v(f(y), q)$, for all f(x) and f(y) in R^I and q in Q.

Again, $\mu_v(f(x)f(y), q) = \mu_v(f(xy), q) \geq \mu_A(xy, q) \geq \mu_A(x, q) \wedge \mu_A(y, q)$, which implies that $\mu_v(f(x)f(y), q) \geq \mu_v(f(x),q)\wedge\mu_v(f(y), q)$, for all f(x) and f(y) in R^I and q in Q. Also, $\nu_v(f(x) - f(y), q) = \nu_v(f(x - y), q) \leq \nu_A(x - y, q) \leq \nu_A(x, q)\vee\nu_A(y, q)$, which implies that $\nu_v(f(x) - f(y), q) \leq \nu_v(f(x), q) \vee \nu_v(f(y), q)$, for all f(x) and f(y) in R^I and q in Q.

Again, $\nu_v(f(x)f(y) , q) = \nu_v(f(xy), q) \leq \nu_A(xy, q) \leq \nu_A(x, q) \vee \nu_A(y, q)$, which implies that $\nu_v(f(x)f(y), q) \leq \nu_v(f(x), q)\vee\nu_v (f(y), q)$, for all f(x) and f(y) in R^I and q in Q. Hence V is a Q-intuitionistic L-fuzzy subnearring of R^I.

2.2 Theorem: Let (R, +, .) and (R^I, +, .) be any two nearrings. The homomorphic preimage of a Q-intuitionistic L-fuzzy subnearring of $f(R)=R^I$ is a Q-intuitionistic L-fuzzy subnearring of R.

Proof: Let (R, +, .) and (R^I, +, .) be any two nearrings. Let f : $R \to R^I$ be a homomorphism. Then, $f(x+y) = f(x) + f(y)$ and $f(xy) = f(x) f(y)$, for all x and y in R. Let V be a Q-intuitionistic L-fuzzy subnearring of $f(R) = R^I$.

We have to prove that A is a Q-intuitionistic L-fuzzy subnearring of R. Let x and y in R.

Then, $\mu_A(x - y, q) = \mu_v(f(x - y), q) = \mu_v(f(x)-f(y), q) \geq \mu_v(f(x), q)\wedge \mu_v(f(y), q)= \mu_A(x, q)\wedge\mu_A(y, q)$, which implies that $\mu_A(x- y, q) \geq\mu_A(x, q) \wedge \mu_A(y, q)$, for all x and y in R and q in Q.

Again, $\mu_A(xy, q) = \mu_v(f(xy) , q)= \mu_v(f(x)f(y) , q)\geq \mu_v(f(x), q)\wedge\mu_v(f(y), q)=\mu_A(x, q) \wedge \mu_A(y, q)$, which implies that $\mu_A(xy, q) \geq \mu_A(x, q) \wedge \mu_A(y, q)$, for all x and y in R and q in Q.

Also, $\nu_A(x -y, q) = \nu_v(f(x- y), q) = \nu_v(f(x) - f(y), q)\leq \nu_v(f(x), q) \vee \nu_v(f(y), q)= \nu_A(x, q) \vee \nu_A(y, q)$, which implies that $\nu_A(x-y, q) \leq \nu_A(x, q)\vee\nu_A(y, q)$, for all x and y in R and q in Q.

Again, $\nu_A(xy, q) = \nu_v(f(xy), q) = \nu_v(f(x)f(y), q) \leq \nu_v(f(x), q) \vee \nu_v(f(y), q)= \nu_A(x, q) \vee \nu_A(y, q)$, which implies that $\nu_A(xy, q) \leq \nu_A(x, q) \vee \nu_A(y, q)$, for all x and y in R and q in Q. Hence A is a Q-intuitionistic L-fuzzy subnearring of R.

2.3 Theorem: Let (R, +,.) and (R^I, +, .) be any two nearrings. The anti-homomorphic image of a Q-intuitionistic L-fuzzy subnearring of R is a Q-intuitionistic L-fuzzy subnearring of $f(R) = R^I$.

Proof: Let (R, +, .) and (R^I, +, .) be any two nearrings. Let f : $R \to R^I$ be an anti-homomorphism. Then, $f(x+y) = f(y) + f(x)$ and $f(xy) = f(y) f(x)$, for all x and y in R. Let A be a Q-intuitionistic L-fuzzy subnearring of R.

We have to prove that V is a Q-intuitionistic L-fuzzy subnearring of $f(R) = R^I$. Now, for f(x), f(y) in R^I and q in Q, $\mu_v (f(x) - f(y), q) = \mu_v(f(y- x), q) \geq \mu_A(y- x, q) \geq \mu_A(y, q) \wedge \mu_A(x, q) = \mu_A(x, q)\wedge\mu_A(y, q)$, which implies that $\mu_v(f(x) - f(y), q) \geq \mu_v(f(x), q) \wedge \mu_v(f(y), q)$, for all f(x) and f(y) in R^I and q in Q.

Again, $\mu_v(f(x)f(y), q) = \mu_v(f(yx), q) \geq \mu_A(yx, q) \geq \mu_A(y, q) \wedge\mu_A(x, q) = \mu_A(x, q)\wedge \mu_A(y, q)$, which implies that $\mu_v(f(x)f(y), q)\geq \mu_v(f(x), q)\wedge \mu_v(f(y), q)$, , for all f(x) and f(y) in R^I and q in Q. Also, $\nu_v(f(x) - f(y), q) = \nu_v(f(y - x), q)\leq\nu_A(y - x, q) \leq \nu_A(y, q) \vee\nu_A(x, q) = \nu_A(x, q)\vee\nu_A(y, q)$, which implies that $\nu_v(f(x) - f(y), q) \leq \nu_v(f(x), q) \vee \nu_v(f(y), q)$, for all f(x) and f(y) in R^I and q in Q.

Again, $\nu_v(f(x)f(y), q) = \nu_v(f(yx), q) \leq \nu_A(yx, q) \leq \nu_A(y, q) \vee \nu_A(x, q) = \nu_A(x, q) \vee \nu_A(y, q)$, which implies that $\nu_v(f(x)f(y), q) \leq \nu_v(f(x), q) \vee \nu_v(f(y), q)$, for all f(x) and f(y) in R^l and q in Q. Hence V is a Q-intuitionistic L-fuzzy subnearring of R^l.

2.4 Theorem: Let (R, +, .) and (R^l, +, .) be any two nearrings. The anti-homomorphic preimage of a Q-intuitionistic L-fuzzy subnearring of f(R) = R^l is a Q-intuitionistic L-fuzzy subnearring of R.

Proof: Let (R, +, .) and (R^l, +, .) be any two nearrings. Let f: R $\rightarrow$ R^l be an anti-homomorphism.

Then, f(x+y) = f(y) + f(x) and f(xy) = f(y) f(x), for all x and y in R. Let V be a Q-intuitionistic L-fuzzy subnearring of f(R) = R^l.

We have to prove that A is a Q-intuitionistic L-fuzzy subnearring of R.

Let x and y in R, then $\mu_A(x–y, q) =\mu_v(f(x–y) ,q) = \mu_v(f(y) –f(x), q) \geq \mu_v(f(y), q)\wedge\mu_v(f(x), q)= \mu_v(f(x), q)\wedge\mu_v(f(y), q) = \mu_A(x, q) \wedge \mu_A(y, q)$, which implies that $\mu_A(x – y, q) \geq \mu_A(x) \wedge \mu_A(y)$, for all x and y in R and q in Q.

Again, $\mu_A(xy, q) = \mu_v(f(xy), q) =\mu_v(f(y)f(x), q) \geq \mu_v(f(y), q) \wedge \mu_v(f(x), q) = \mu_v(f(x), q) \wedge \mu_v(f(y), q)= \mu_A(x, q) \wedge \mu_A(y, q)$, which implies that $\mu_A(xy, q) \geq \mu_A(x, q) \wedge \mu_A(y, q)$, for all x and y in R and q in Q.

Also, $\nu_A(x –y, q) = \nu_v(f(x – y), q) = \nu_v(f(y) –f(x), q) \leq \nu_v(f(y), q)\vee\nu_v(f(x), q)= \nu_v(f(x), q)\vee\nu_v(f(y), q)= \nu_A(x, q) \vee \nu_A(y, q)$, which implies that $\nu_A(x –y, q) \leq \nu_A(x, q)\vee \nu_A(y, q)$, for all x and y in R and q in Q.

Again, $\nu_A(xy, q) = \nu_v(f(xy), q) = \nu_v(f(y)f(x), q) \leq \nu_v(f(y), q) \vee \nu_v(f(x), q) = \nu_v(f(x), q) \vee\nu_v(f(y), q) = \nu_A(x, q) \vee \nu_A(y, q)$, which implies that $\nu_A(xy, q) \leq \nu_A(x, q) \vee \nu_A(y, q)$, for all x and y in R and q in Q. Hence A is a Q-intuitionistic L-fuzzy subnearring of R.

2.5 Theorem: Let (R, +, .) and (R^l, +, .) be any two nearrings. The homomorphic image of a Q-intuitionistic L-fuzzy normal subnearring of R is a Q-intuitionistic L-fuzzy normal subnearring of f(R) = R^l.

Proof: Let (R, +, .) and (R^l, +, .) be any two nearrings and f : R $\rightarrow$ R^l be a homomorphism. Then f(x+y) = f(x)+ f(y) and f(xy) = f(x) f(y), for all x and y in R.

Let A be a Q-intuitionistic L-fuzzy normal subnearring of a nearring R. We have to prove that V is a Q-intuitionistic L-fuzzy normal subnearring of a nearring R^l.

Now, for f(x), f(y) in R^l, clearly V is a Q-intuitionistic L-fuzzy subnearring of the nearring R^l, since A is a Q-intuitionistic L-fuzzy subnearring of a nearring R.

Now, $\mu_v(f(x) + f(y), q) = \mu_v(f(x + y), q) \geq \mu_A(x + y, q) = \mu_A(y + x, q) \leq \mu_v(f(y + x), q) = \mu_v(f(y) + f(x), q)$, which implies that $\mu_v(f(x) + f(y), q) = \mu_v(f(y) + f(x), q)$, for all f(x) and f(y) in R^l and q in Q.

Also, $\nu_v(f(x) + f(y), q) = \nu_v(f(x + y), q) \leq \nu_A(x + y, q) = \nu_A(y + x, q) \geq \nu_v(f(y + x), q) = \nu_v(f(y) + f(x), q)$, which implies that $\nu_v(f(x) + f(y), q) = \nu_v(f(y) + f(x), q)$, for all f(x) and f(y) in R^l and q in Q.

Now, $\mu_v(f(x)f(y), q) = \mu_v(f(xy), q) \geq \mu_A(xy, q) = \mu_A(yx, q) \leq \mu_v(f(yx), q) = \mu_v(f(y) f(x), q)$, which implies that $\mu_v(f(x)f(y), q) = \mu_v(f(y) f(x), q)$, for all f(x) and f(y) in R^l and q in Q.

Also, $\nu_v(f(x)f(y), q) = \nu_v(f(xy), q)\leq \nu_A(xy, q) = \nu_A(yx, q) \geq \nu_v(f(yx), q) =\nu_v(f(y) f(x), q)$, which implies that $\nu_v(f(x)f(y), q) = \nu_v(f(y) f(x), q)$, for all f(x) and f(y) in R^l and q in Q. Hence V is a Q-intuitionistic L-fuzzy normal subnearring of a nearring R^l.

2.6 Theorem: Let (R, +, .) and (R^l, +, .) be any two nearrings. The homomorphic preimage of a Q-intuitionistic L-fuzzy normal subnearring of f(R) = R^l is a Q-intuitionistic L-fuzzy normal subnearring of R.

Proof: Let (R, +, .) and (R^l, +, .) be any two nearrings and f : R $\rightarrow$ R^l be a homomorphism. Then f(x+y) = f(x) + f(y) and f(xy) = f(x) f(y), for all x and y in R. Let V be a Q-intuitionistic L-fuzzy normal subnearring of a nearring f(R) = R^l.

We have to prove that A is an intuitionistic L-fuzzy normal subnearring of a nearring R. Let x and y in R and q in Q. Then, clearly A is a Q-intuitionistic L-fuzzy subnearring of a nearring R, since V is a Q-intuitionistic L-fuzzy subnearring of a nearring R^l.

Now, $\mu_A(x + y, q) = \mu_v(f(x + y), q) = \mu_v(f(x) + f(y), q)= \mu_v(f(y) + f(x), q) = \mu_v(f(y + x), q) = \mu_A(y + x, q)$, which implies that $\mu_A(x + y, q) = \mu_A(y + x, q)$, for all x and y in R and q in Q.

Also, $\nu_A(x + y, q) = \nu_v(f(x + y), q) = \nu_v(f(x) + f(y), q) = \nu_v(f(y) + f(x), q) = \nu_v(f(y + x), q) = \nu_A(y + x, q)$, which implies that $\nu_A(x + y, q) = \nu_A(y + x, q)$, for all x and y in R.

Now, $\mu_A(xy, q) = \mu_v(f(xy), q) = \mu_v(f(x)f(y), q) = \mu_v(f(y)f(x), q) = \mu_v(f(yx), q) = \mu_A(yx, q)$, which implies that $\mu_A(xy, q) = \mu_A(yx, q)$, for all x and y in R and q in Q.

Also, $\nu_A(xy, q) = \nu_v(f(xy), q) = \nu_v(f(x)f(y), q) = \nu_v(f(y)f(x), q) = \nu_v(f(yx), q) = \nu_A(yx, q)$, which implies that $\nu_A(xy, q) = \nu_A(yx, q)$, for all x and y in R. Hence A is a Q-intuitionistic L-fuzzy normal subnearring of a nearring R.

2.7 Theorem: Let (R, +, .) and (R^l, +, .) be any two nearrings. The anti-homomorphic image of a Q-intuitionistic L-fuzzy normal subnearring of R is a Q-intuitionistic L-fuzzy normal subnearring of $f(R) = R^l$.

Proof: Let (R, +, .) and (R^l, +, .) be any two nearrings and $f : R \rightarrow R^l$ be an anti-homomorphism. Then $f(x+y) = f(y) + f(x)$ and $f(xy) = f(y) f(x)$, for all x and y in R. Let A be a Q-intuitionistic L-fuzzy normal subnearring of a nearring R.

We have to prove that V is a Q-intuitionistic L-fuzzy normal subnearring of a nearring $f(R) = R^l$. Now, for f(x), f(y) in R^l, clearly V is a Q-intuitionistic L-fuzzy subnearring of a nearring R^l, since A is a Q-intuitionistic L-fuzzy subnearring of a nearring R.

Now, $\mu_v(f(x) + f(y), q) = \mu_v(f(y + x), q) \geq \mu_A(y + x, q) = \mu_A(x + y, q) \leq \mu_v(f(x + y), q) = \mu_v(f(y) + f(x), q)$, which implies that $\mu_v(f(x) + f(y), q) = \mu_v(f(y) + f(x), q)$, for all f(x) and f(y) in R^l and q in Q.

Also, $\nu_v(f(x) + f(y), q) = \nu_v(f(y + x), q) \leq \nu_A(y + x, q) = \nu_A(x + y, q) \geq \nu_v(f(x + y), q) = \nu_v(f(y) + f(x), q)$, which implies that $\nu_v(f(x) + f(y), q) = \nu_v(f(y) + f(x), q)$, for all f(x) and f(y) in R^l and q in Q.

Now, $\mu_v(f(x)f(y), q) = \mu_v(f(yx), q) \geq \mu_A(yx, q) = \mu_A(xy, q) \leq \mu_v(f(xy), q) = \mu_v(f(y) f(x), q)$, which implies that $\mu_v(f(x)f(y), q) = \mu_v(f(y) f(x), q)$, for all f(x) and f(y) in R^l and q in Q. Also, $\nu_v(f(x)f(y), q) = \nu_v(f(yx), q) \leq \nu_A(yx, q) = \nu_A(xy, q) \geq \nu_v(f(xy), q) = \nu_v(f(y) f(x), q)$, which implies that $\nu_v(f(x)f(y), q) = \nu_v(f(y) f(x), q)$, for all f(x) and f(y) in R^l and q in Q. Hence V is a Q-intuitionistic L-fuzzy normal subnearring of the nearring $f(R) = R^l$.

2.8 Theorem: Let (R, +, .) and (R^l, +, .) be any two nearrings. The anti-homomorphic preimage of a Q-intuitionistic L-fuzzy normal subnearring of $f(R) = R^l$ is a Q-intuitionistic L-fuzzy normal subnearring of R.

Proof: Let (R, +, .) and (R^l, +, .) be any two nearrings and $f : R \rightarrow R^l$ be an anti-homomorphism. Then $f(x+y) = f(y) + f(x)$ and $f(xy) = f(y) f(x)$, for all x and y in R. Let V be a Q-intuitionistic L-fuzzy normal subnearring of the nearring $f(R) = R^l$.

We have to prove that A is a Q-intuitionistic L-fuzzy normal subnearring of a nearring R. Let x and y in R, then, clearly A is a Q-intuitionistic L-fuzzy subnearring of a nearring R, since V is a Q-intuitionistic L-fuzzy subnearring of the nearring $f(R) = R^l$.

Now, $\mu_A(x + y, q) = \mu_v(f(x + y), q) = \mu_v(f(y) + f(x), q) = \mu_v(f(x) + f(y), q) = \mu_v(f(y + x), q) = \mu_A(y + x, q)$, which implies that $\mu_A(x + y, q) = \mu_A(y + x, q)$, for all x and y in R and q in Q.

Also, $\nu_A(x + y, q) = \nu_v(f(x + y), q) = \nu_v(f(y) + f(x), q) = \nu_v(f(x) + f(y), q) = \nu_v(f(y + x), q) = \nu_A(y + x, q)$, which implies that $\nu_A(x + y, q) = \nu_A(y + x, q)$, for all x and y in R and q in Q.

Now, $\mu_A(xy, q)=\mu_v(f(xy), q) = \mu_v(f(y)f(x), q) = \mu_v(f(x)f(y), q) = \mu_v(f(yx), q) =\mu_A(yx, q)$, which implies that $\mu_A(xy, q) = \mu_A(yx, q)$, for all x and y in R and q in Q.

Also, $\nu_A(xy, q)=\nu_v(f(xy), q) = \nu_v(f(y)f(x), q) = \nu_v(f(x)f(y), q) = \nu_v(f(yx), q) =\nu_A(yx, q)$, which implies that $\nu_A(xy, q) = \nu_A(yx, q)$, for all x and y in R and q in Q.Hence A is a Q-intuitionistic L-fuzzy normal subnearring of the nearring R.

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