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Mappings on Neutrosophic Soft Classes

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Abstract. In 1995 Smarandache introduced the concept of neutrosophic set which is a mathematical tool for handling problems involving imprecise, indeterminacy and inconsistent data. In 2013 Maji introduced the concept of neutrosophic soft set theory as a general mathematical tool for dealing with uncertainty. In this paper we define the notion of a mapping on classes where the neutrosophic soft classes are collections of neutrosophic soft set. We also define and study the properties of neutrosophic soft images and neutrosophic soft inverse images of neutrosophic soft sets.

Keywords: soft set, fuzzy soft set, neutrosophic soft set, neutrosophic soft classes, mapping on neutrosophic soft classes, neutrosophic soft images, neutrosophic soft inverse images.

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1 Introduction

Most of the problems in engineering, medical science, economics, environments etc. have various uncertainties. in 1995, Smarandache talked for the first time about neutrosophy and in 1999 and 2005 [15, 16] he initiated the theory of neutrosophic set as a new mathematical tool for handling problems involving imprecise, indeterminacy, and inconsistent data. Molodtsov [8] initiated the concept of soft set theory as a mathematical tool for dealing with uncertainties. Chen et al. [7] and Maji et al. [11, 9] studied some different operations and application of soft sets. Furthermore Maji et al. [10] presented the definition of fuzzy soft set and Roy et al. [12] presented the applications of this notion to decision making problems. Alkhazaleh et al. [4] generalized the concept of fuzzy soft set to neutrosophic soft set and they gave some applications of this concept in decision making and medical diagnosis. They also introduced the concept of fuzzy parameterized interval-valued fuzzy soft set [3], where the mapping is defined from the fuzzy set parameters to the interval-valued fuzzy subsets of the universal set, and gave an application of this concept in decision making. Alkhazaleh and Salleh [2] introduced the concept of soft expert sets where the user can know the opinion of all experts in one model and gave an application of this concept in decision making problem. As a generalization of Molodtsov's soft set, Alkhazaleh et al. [5] presented the definition of a soft multiset and its basic operations such as complement, union and intersection. In 2012 Alkhazaleh and Salleh [6] introduced the concept of fuzzy soft multiset as a combination of soft multiset and fuzzy set and studied its properties and operations. They presented the applications of this concept to decision making problems. In 2012 Salleh et al. [1] introduced the notion of multiparameterized soft set and studied its properties. In 2010 Kharal and Ahmad [14] introduced the notion of mapping on soft classes where the soft classes are collections of soft sets. They also defined and studied the properties of soft images and soft inverse images of soft sets and gave the application of this mapping in medical diagnosis. They defined the notion of a mapping on classes of fuzzy soft sets. They also defined and studied the properties of fuzzy soft images and fuzzy soft inverse images of fuzzy soft sets (see [13]). In 2009 Bhowmik and Pal [18] studied the concept of intuitionistic neutrosophic set, and Maji [17] introduced neutrosophic soft set, established its application in decision making, and thus opened a new direction, new path of thinking to engineers, mathematicians, computer scientists and many others in various tests. In 2013 Said and Smarandache [19] defined the concept of intuitionistic neutrosophic soft set and introduced some operations on intuitionistic neutrosophic soft set and some properties of this concept have been established. In this paper we define the notion of a mapping on classes where the neutrosophic soft classes are collections of neutrosophic soft set. We also define and study the properties of neutrosophic soft images and neutrosophic soft inverse images of neutrosophic soft sets.

2 Preliminaries

In this section, we recall some basic notions in neutrosophic set theory, soft set theory and neutrosophic soft set theory . Smarandache defined neutrosophic set in the following way.

Definition 2.1 *[15] A neutrosophic set* A *on the universe of discourse* X *is defined as* $A=\{<x,T_A(x),I_A(x),F_A(x)>,x\in X\}$ *where* T, I, $F:X\to]^-0,1^+[$ *and* $^-0\leq T_A(x)+I_A(x)+F_A(x)\leq 3^+$.

Smarandache explained his concept as follows: "for example, neutrosophic logic is a generalization of the fuzzy logic. In neutrosophic logic a proposition is $T\equiv true$, $I\equiv indeterminate$, and $F\equiv false$. For example, let's analyze the following proposition: "Pakistan will win against India in the next soccer game". This proposition can be $(0.6,0.3,0.1)$ which means that there is possibility of $60\%\equiv$ that Pakistan wins, $30\%\equiv$ that Pakistan has a tie game, and $10\%\equiv$ that Pakistan looses in the next game vs. India."

Molodtsov defined soft set in the following way. Let U be a universe and E be a set of parameters. Let $P(U)$ denote the power set of U and $A\subseteq E$.

Definition 2.2 *[8] A pair* (F,A) *is called a soft set over* U, *where* F *is a mapping*

$$F:A\to P(U).$$

In other words, a soft set over U is a parameterized family of subsets of the universe U. For $\varepsilon\in A, F(\varepsilon)$ may be considered as the set of ε-approximate elements of the soft set (F,A).

Definition 2.3 *[17] Let* U *be an initial universe set and* E *be a set of parameters. Consider* $A\subset E$. *Let* $P(U)$ *denotes the set of all neutrosophic sets of* U. *The collection* (F,A) *is termed to be the neutrosophic soft set (NSS in short) over* U, *where* F *is a mapping given by* $F:A\to P(U)$.

Example 2.1 *Suppose that* $U=\{c_1,c_2,c_3\}$ *is the set of color cloths under consideration,* $A=\{e_1,e_2,e_3\}$ *is the set of parameters, where* e_1 *stands for the parameter 'color' which consists of red, green and blue,* e_2 *stands for the parameter 'ingredient' which is made from wool, cotton and acrylic, and* e_3 *stands for the parameter 'price' which can be various: high, medium and low. We define neutrosophic soft set as follows:*

$$F(e_1)=\{<c_1,0.4,0.2,0.3>,<c_2,0.7,0.3,0.4>,<c_3,0.5,0.2,0.2>\},$$
$$F(e_2)=\{<c_1,0.6,0.2,0.6>,<c_2,0.9,0.4,0.1>,<c_3,0.4,0.3,0.3>\},$$
$$F(e_3)=\{<c_1,0.3,0.3,0.7>,<c_2,0.7,0.2,0.4>,<c_3,0.5,0.6,0.4>\}.$$

Definition 2.4 *[17] Let* (F,A) *and* (G,B) *be two neutrosophic soft sets over the common universe* U. (F,A) *is said to be neutrosophic soft subset of* (G,B) *if* $A\subset B$, *and* $T_F(e)(x)\leq T_G(e)(x)$, $I_F(e)(x)\leq I_G(e)(x)$, $F_F(e)(x)\geq F_G(e)(x)$, $\forall e\in A, x\in U$. *We denote it by* $(F,A)\subseteq(G,B)$. (F,A) *is said to be neutrosophic soft super set of* (G,B) *if* (G,B) *is a neutrosophic soft subset of* (F,A). *We denote it by* $(F,A)\supseteq(G,B)$.

Definition 2.5 *[17] Let* (H,A) *and* (G,B) *be two NSSs over the common universe* U. *Then the union of* (H,A) *and* (G,B) *is denoted by* `$(H,A)\cup(G,B)$` *and is defined by* $(H,A)\cup(G,B)=(K,C)$, *where* $C=A\cup B$ *and the truth-membership, indeterminacy-membership and falsity-membership of* (K,C) *are defined as follows:*

$$T_K(e)(m)=T_H(e)(m),\quad \text{if } e\in A-B,$$
$$=T_G(e)(m),\quad \text{if } e\in B-A,$$
$$=max(T_H(e)(m),T_G(e)(m)),\quad \text{if } e\in A\cap B.$$
$$I_K(e)(m)=I_H(e)(m),\quad \text{if } e\in A-B,$$
$$=I_G(e)(m),\quad \text{if } e\in B-A,$$
$$=\frac{I_H(e)(m)+I_G(e)(m))}{2},\quad \text{if } e\in A\cap B.$$
$$F_K(e)(m)=F_H(e)(m),\quad \text{if } e\in A-B,$$
$$=F_G(e)(m),\quad \text{if } e\in B-A,$$
$$=min(F_H(e)(m),F_G(e)(m)),\quad \text{if } e\in A\cap B.$$

Definition 2.6 *[17] Let* (H,A) *and* (G,B) *be two NSSs over the common universe* U. *Then the intersection of* (H,A) *and* (G,B) *is denoted by* `$(H,A)\cap(G,B)$` *and is defined by* $(H,A)\cap(G,B)=(K,C)$, *where* $C=A\cup B$ *and the truth-membership, indeterminacy-membership and falsity-membership of* (K,C) *are as follows:*

$$T_K(e)(m)=min(T_H(e)(m),T_G(e)(m)),$$
$$I_K(e)(m)=\frac{I_H(e)(m)+I_G(e)(m))}{2},$$
$$F_K(e)(m)=max(F_H(e)(m),F_G(e)(m)),\quad \forall e\in C.$$

Definition 2.7 *[17] Let* (H,A) *and* (G,B) *be two NSSs over the common universe* U. *Then the 'AND' operation on them is denoted by* `$(H,A)\wedge(G,B)$` *and is defined by* $(H,A)\wedge(G,B)=(K,A\times B)$, *where the truth-membership, indeterminacy-membership and falsity-membership of* $(K,A\times B)$ *are as follows:*

$$T_K(\alpha,\beta)(m)=min(T_H(\alpha)(m),T_G(\beta)(m)),$$
$$I_K(\alpha,\beta)(m)=\frac{I_H(\alpha)(m)+I_G(\beta)(m))}{2} \text{ and}$$

$$F_K(\alpha,\beta)(m) = max(F_H(\alpha)(m), F_G(\beta)(m)), \quad \forall \alpha \in A, \forall \beta \in B.$$

Definition 2.8 *[17] Let (H,A) and (G,B) be two NSSs over the common universe U. Then the 'OR' operation on them is denoted by `$(H,A)\bigvee(G,B)$` and is defined by $(H,A)\bigvee(G,B)=(O,A\times B)$, where the truth-membership, indeterminacy-membership and falsity-membership of $(O,A\times B)$ are as follows:*

$$T_O(\alpha,\beta)(m) = max(T_H(\alpha)(m), T_G(\beta)(m)),$$

$$I_O(\alpha,\beta)(m) = \frac{I_H(\alpha)(m) + I_G(\beta)(m))}{2}$$

and

$$F_O(\alpha,\beta)(m) = min(F_H(\alpha)(m), F_G(\beta)(m)), \quad \forall \alpha \in A, \forall \beta \in B.$$

3 Mapping on Neutrosophic Soft Classes

In this section, we introduce the notion of mapping on neutrosophic soft classes. Neutrosophic soft classes are collections of neutrosophic soft sets. We also define and study the properties of neutrosophic soft images and neutrosophic soft inverse images of neutrosophic soft sets, and support them with example and theorems.

Definition 3.1 *Let X be a universe and E be a set of parameters. Then the collection of all neutrosophic soft sets over X with parameters from E is called a neutrosophic soft class and is denoted as $(\tilde{X,E})$.*

Definition 3.2 *Let $(\tilde{X,E})$ and $(\tilde{Y,E'})$ be neutrosophic soft classes. Let $r: X \to Y$ and $s: E \to E'$ be mappings. Then a mapping $f:(\tilde{X,E}) \to (\tilde{Y,E'})$ is defined as follows:*

For a neutrosophic soft set (F,A) in $(\tilde{X,E})$, $f(F,A)$ is a neutrosophic soft set in $(\tilde{Y,E'})$ obtained as follows:

$$f(F,A)(\beta)(y) = \begin{cases} \bigvee_{x \in r^{-1}(y)} \left(\bigvee_{\alpha} F(\alpha) \right), \\ if\ r^{-1}(y) \neq \varnothing \ and \quad s^{-1}(\beta) \cap A \neq \varnothing, \\ (0,0,0) \quad otherwise. \end{cases}$$

For $\beta \in s(E) \subseteq E'$, $y \in Y$ and $\forall \alpha \in s^{-1}(\beta) \cap A$.

$f(F,A)$ is called a *neutrosophic soft image* of the neutrosophic soft set (F,A).

Definition 3.3 *Let $(\tilde{X,E})$ and $(\tilde{Y,E'})$ be neutrosophic soft classes. Let $r: X \to Y$ and $s: E \to E'$ be mappings. Then a mapping $f^{-1}:(\tilde{Y,E'}) \to (\tilde{X,E})$ is defined as follows:*

For a neutrosophic soft set (G,B) in $(\tilde{Y,E'})$, $f^{-1}(G,B)$ is a neutrosophic soft set in $(\tilde{X,E})$ obtained as follows:

$$f^{-1}(G,B)(\alpha)(x) = \begin{cases} G(s(\alpha))(r(x),) \quad if\ s(\alpha) \in B, \\ (0,0,0) \quad otherwise. \end{cases}$$

For $\alpha \in s^{-1}(B) \subseteq E$ and $x \in X$. $f^{-1}(G,B)$ is called a *neutrosophic soft inverse image* of the neutrosophic soft set (G,B).

Example 3.1 *Let $X = \{x_1, x_2, x_3\}$, $Y = \{y_1, y_2, y_3\}$ and let $E = \{e_1, e_2, e_3\}$ and $E' = \{e_1', e_2', e_3'\}$. Suppose that $(\tilde{X,E})$ and $(\tilde{Y,E'})$ are neutrosophic soft classes. Define $r: X \to Y$ and $s: E \to E'$ as follows:*

$$r(x_1) = y_1, \; r(x_2) = y_3, \; r(x_3) = y_3,$$
$$s(e_1) = e_1', \; s(e_2) = e_3', \; s(e_3) = e_2'.$$

Let (F,A) and (G,B) be two neutrosophic soft sets over X and Y respectively such that

$$\begin{aligned}(F,A) = \{&(e_1, \{<x_1, 0.4, 0.2, 0.3>, <x_2, 0.7, 0.3, 0.4>, <x_3, 0.5, 0.2, 0.2>\}),\\ &(e_2, \{<x_1, 0.2, 0.2, 0.7>, <x_2, 0.3, 0.1, 0.8>, <x_3, 0.2, 0.3, 0.6>\}),\\ &(e_3, \{<x_1, 0.8, 0.2, 0.1>, <x_2, 0.9, 0.1, 0.1>, <x_3, 0.1, 0.4, 0.5>\})\},\end{aligned}$$

$$\begin{aligned}(G,B) = \{&(e_1', \{<y_1, 0.2, 0.4, 0.5>, <y_2, 0.1, 0.2, 0.6>, <y_3, 0.2, 0.5, 0.3>\}),\\ &(e_2', \{<y_1, 0.8, 0.1, 0.1>, <y_2, 0.5, 0.5, 0.5>, <y_3, 0.3, 0.4, 0.4>\}),\\ &(e_3', \{<y_1, 0.7, 0.3, 0.3>, <y_2, 0.9, 0.2, 0.1>, <y_3, 0.8, 0.2, 0.1>\})\},\end{aligned}$$

Then we define a mapping $f:(\tilde{X,E}) \to (\tilde{Y,E'})$ as follows:

For a neutrosophic soft set (F,A) in $(\tilde{X,E})$, $f(F,A)$ is a neutrosophic soft set in $(\tilde{Y,E'})$ and is obtained as follows:

$$f(F,A)(e_1')(y_1) = \left(\bigvee_{x \in r^{-1}(y_1)} \left(\bigvee_{\alpha} F(\alpha) \right) \right)$$

$$=\left(\bigvee_{x\in\{x_1\}}\left(\bigvee_{\alpha\in\{e_1\}}F(\alpha)\right)\right)$$

$$=\left(\bigvee_{x\in\{x_1\}}\left(\{<x_1,0.4,0.2,0.3>,<x_2,0.7,0.3,0.4>,<x_3,0.5,0.2,0.2>\}\right)\right)$$

$=(0.4,0.2,0.3)$.

$$f(F,A)(e_1')(y_2)=\left(\bigvee_{x\in r^{-1}(y_2)}\left(\bigvee_{\alpha}F(\alpha)\right)\right)$$

$=(0,0,0)$ as $r^{-1}(y_2)=\varnothing$.

$$f(F,A)(e_1')(y_3)=\left(\bigvee_{x\in r^{-1}(y_3)}\left(\bigvee_{\alpha}F(\alpha)\right)\right)$$

$$=\left(\bigvee_{x\in\{x_2,x_3\}}\left(\bigvee_{\alpha\in\{e_1\}}F(\alpha)\right)\right)$$

$$=\left(\bigvee_{x\in\{x_2,x_3\}}\left(\{<x_1,0.4,0.2,0.3>,<x_2,0.7,0.3,0.4>,<x_3,0.5,0.2,0.2>\}\right)\right)$$

$$=\left(\max(0.7,0.5),\frac{0.3+0.2}{2},\min(0.4,0.2)\right)=(0.7,0.25,0.2).$$

By similar calculations, consequently, we get

$$\left(f(F,A),B\right)=\{\left(e_1',\{<y_1,0.4,0.2,0.3>,<y_2,0,0,0>,<y_3,0.7,0.25,0.2>\}\right),$$
$$\left(e_2',\{<y_1,0.8,0.2,0.1>,<y_2,0,0,0>,<y_3,0.9,0.25,0.1>\}\right),$$
$$\left(e_3',\{<y_1,0.2,0.2,0.7>,<y_2,0,0,0>,<y_3,0.3,0.2,0.6>\}\right)\}.$$

Next for the neutrosophic soft inverse images, the mapping $f^{-1}:\left(\widetilde{Y,E'}\right)\to\left(\widetilde{X,E}\right)$ is defined as follows:

For a neutrosophic soft set (G,B) in $\left(\widetilde{Y,E'}\right)$, $\left(f^{-1}(G,B),A\right)$ is a neutrosophic soft set in $\left(\widetilde{X,E}\right)$ obtained as follows:

$$f^{-1}(G,B)(e_1)(x_1)=\left(G\left(s(e_1)\right)\left(r(x_1)\right)\right)$$
$$=\left(G\left(e_1'\right)(y_1)\right)$$
$$=(0.2,0.4,0.5),$$
$$f^{-1}(G,B)(e_1)(x_2)=\left(G\left(s(e_1)\right)\left(r(x_2)\right)\right)$$
$$=\left(G\left(e_1'\right)(y_3)\right)$$
$$=(0.2,0.5,0.3),$$
$$f^{-1}(G,B)(e_1)(x_3)=\left(G\left(s(e_1)\right)\left(r(x_3)\right)\right)$$
$$=\left(G\left(e_1'\right)(y_3)\right)$$
$$=(0.2,0.5,0.3).$$

By similar calculations, consequently, we get

$$\left(f^{-1}(G,B),A\right)=\{\left(e_1,\{<x_1,0.2,0.4,0.5>,<x_2,0.2,0.5,0.3>,<x_3,0.2,0.5,0.3>\}\right),$$
$$\left(e_2,\{<x_1,0.7,0.3,0.3>,<x_2,0.8,0.2,0.1>,<x_3,0.8,0.2,0.1>\}\right),$$
$$\left(e_3,\{<x_1,0.8,0.1,0.1>,<x_2,0.3,0.4,0.4>,<x_3,0.3,0.4,0.4>\}\right)\}.$$

Definition 3.4 *Let $f:\left(\widetilde{X,E}\right)\to\left(\widetilde{Y,E'}\right)$ be a mapping and (F,A) and (G,B) neutrosophic soft sets in $\left(\widetilde{X,E}\right)$. Then for $\beta\in E'$, $y\in Y$, the neutrosophic soft union and intersection of neutrosophic soft images (F,A) and (G,B) are defined as follows:*

$$\left(f(F,A)\tilde{\bigvee}f(G,B)\right)(\beta)(y)=f(F,A)(\beta)(y)\bigvee f(G,B)(\beta)(y).$$

$$\left(f(F,A)\tilde{\wedge}f(G,B)\right)(\beta)(y)=f(F,A)(\beta)(y)\wedge f(G,B)(\beta)(y).$$

Definition 3.5 *Let $f:\left(\widetilde{X,E}\right)\to\left(\widetilde{Y,E'}\right)$ be a mapping and (F,A) and (G,B) neutrosophic soft sets in $\left(X,E'\right)$. Then for $\alpha\in E$, $x\in X$, the neutrosophic soft union and intersection of neutrosophic soft inverse images (F,A) and (G,B) are defined as follows:*

$$\left(f^{-1}(F,A)\tilde{\bigvee}f^{-1}(G,B)\right)(\alpha)(x)=f^{-1}(F,A)(\alpha)(x)\bigvee f^{-1}(G,B)(\alpha)(x).$$

$$\left(f^{-1}(F,A)\tilde{\bigwedge}f^{-1}(G,B)\right)(\alpha)(x)=f^{-1}(F,A)(\alpha)(x)\bigwedge f^{-1}(G,B)(\alpha)(x).$$

Theorem 3.1 *Let $f:\left(\widetilde{X,E}\right)\to\left(\widetilde{Y,E'}\right)$ be a mapping. Then for neutrosophic soft sets (F,A) and (G,B) in the neutrosophic soft class $\left(\widetilde{X,E}\right)$, [a.]*

a. $f(\varnothing)=\varnothing$.

b. $f(X)\subseteq Y$.

c. $f\left((F,A)\tilde{\bigvee}(G,B)\right)=f(F,A)\tilde{\bigvee}f(G,B)$.

d. $f\left((F,A)\tilde{\bigwedge}(G,B)\right)\subseteq f(F,A)\tilde{\bigwedge}f(G,B)$.

e. If $(F,A)\subseteq(G,B)$, then $f(F,A)\subseteq f(G,B)$.

Proof. For (a), (b) and (e) the proof is trivial, so we just give the proof of (c) and (d).

c. For $\beta\in E'$ and $y\in Y$, we want to prove that

$$f\left((F,A)\tilde{\bigvee}(G,B)\right)(\beta)(y)=f(F,A)(\beta)(y)\tilde{\bigvee}f(G,B)(\beta)(y)$$

For left hand side, consider

$f\left((F,A)\tilde{\bigvee}(G,B)\right)(\beta)(y)=f(H,A\cup B)(\beta)(y)$. Then

$$f(H,A\cup B)(\beta)(y)=\begin{cases}\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha}H(\alpha)\right),\\ if\ r^{-1}(y)\neq\varnothing\ and\ s^{-1}(\beta)\cap(A\cup B)\neq\varnothing,\\ (0,0,0)\quad otherwise.\end{cases}\quad(1)$$

where $H(\alpha)=\cup(F(\alpha),G(\alpha))$.

Considering only the non-trivial case, then Equation 1 becomes:

$$f(H,A\cup B)(\beta)(y)=\bigvee_{x\in r^{-1}(y)}\left(\bigvee\cup(F(\alpha),G(\alpha))\right)\qquad(2)$$

For right hand side and by using Definition 3.4, we have

$$\left(f(F,A)\tilde{\bigvee}f(G,B)\right)(\beta)(y)=f(F,A)(\beta)(y)\bigvee f(G,B)(\beta)(y)$$

$$=\left(\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha\in s^{-1}(\beta)\cap A}F(\alpha)\right)\right)\bigvee\left(\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha\in s^{-1}(\beta)\cap B}G(\alpha)\right)\right)$$

$$=\left(\bigvee_{x\in r^{-1}(y)}\bigvee_{\alpha\in s^{-1}(\beta)\cap(A\cup B)}\left(F(\alpha)\bigvee G(\alpha)\right)\right)$$

$$=\bigvee_{x\in r^{-1}(y)}\left(\bigvee\cup(F(\alpha),G(\alpha))\right)\qquad(3)$$

From Equations 2 and 3, we get (c).

d. For $\beta\in E'$ and $y\in Y$, and using Definition 3.4, we have

$$f\left((F,A)\tilde{\bigwedge}(G,B)\right)(\beta)(y)=f(H,A\cup B)(\beta)(y)$$

$$=\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha\in s^{-1}(\beta)\cap(A\cup B)}H(\alpha)\right)$$

$$=\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha\in s^{-1}(\beta)\cap(A\cup B)}F(\alpha)\bigwedge G(\alpha)\right)$$

$$=\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha\in s^{-1}(\beta)\cap(A\cup B)}F(\alpha)\bigwedge G(\alpha)\right)$$

$$\subseteq\left(\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha\in s^{-1}(\beta)\cap A}F(\alpha)\right)\right)\bigwedge\left(\bigvee_{x\in r^{-1}(y)}\left(\bigvee_{\alpha\in s^{-1}(\beta)\cap B}G(\alpha)\right)\right)$$

$$=f((F,A))(\beta)(y)\bigwedge((G,B))(\beta)(y)$$

$$=\left(f(F,A)\tilde{\bigwedge}f(G,B)\right)(\beta)(y).$$

This gives (d).

Theorem 3.2 *Let* $f:(\tilde{X,E})\to(\tilde{Y,E'})$ *be mapping. Then for neutrosophic soft sets* (F,A), (G,B) *in the neutrosophic soft class* (X,E'), *we have:*

1. $f^{-1}(\varnothing)=\varnothing$.
2. $f^{-1}(Y)=X$.
3. $f^{-1}\left((F,A)\tilde{\bigvee}(G,B)\right)=f^{-1}(F,A)\tilde{\bigvee}f^{-1}(G,B)$.
4. $f^{-1}\left((F,A)\tilde{\bigwedge}(G,B)\right)=f^{-1}(F,A)\tilde{\bigwedge}f^{-1}(G,B)$.
5. If $(F,A)\subseteq(G,B)$, then $f^{-1}(F,A)\subseteq f^{-1}(G,B)$.

Proof. We use the same method as in the previous proof.

4 Conclusion

In this paper we have defined the notion of a mapping on classes where the neutrosophic soft classes are collections of neutrosophic soft set. The properties of neutrosophic soft images and neutrosophic soft inverse images of neutrosophic soft sets have been defined and studied.

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