INTRODUCTION

Neutrosophic set, a part of neutrosophy introduced by Smarandache (2005) as a new branch of philosophy, is a mathematical tool dealing with problems involving imprecise, indeterminacy and inconsistent knowledge. A Neutrosophic set consists of three basic membership functions independently of each other, which are truth, indeterminacy and falsity.

Presently work on the Neutrosophic set theory is progressing rapidly. Bhowmik and Pal (2009) defined "Intuitionistic Neutrosophic set". Salama and Alblowi (2012) introduced another concept called "Generalized Neutrosophic set". Wang et al. (2005) introduced the notion of "Interval valued Neutrosophic set". It is characterized by an interval membership degree, interval indeterminacy degree and interval non-membership degree.

In 1999, a Russian researcher, Molodtsov proposed a new mathematical tool called "Soft set" for dealing with uncertainty. Maji et al. (2002) applied soft set theory to decision making problem in 2003 and they introduced some new operations between soft sets. After Maji's work, studies on soft set theory and its applications have been progressing rapidly.

By using the concepts of Neutrosophic set and Soft set, Maji (2012) introduced the concept of 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.

Many researchers have contributed towards the study of Neutrosophic soft set theory. The following are some of the articles published on Neutrosophic soft sets.

1. Neutrosophic soft sets, Maji (2012)

2. Generalized Neutrosophic soft sets, Broumi (2013)

3. Intuitionistic Neutrosophic soft sets, Broumi and Smarandache (2013)

4. Interval valued Neutrosophic soft sets, Deli (2014)

5. Generalised interval valued Neutrosophic soft sets, Broumi, Sahin and Smarandache (2014)

6. Neutrosophic parameterized soft sets, Broumi, Deli and Smarandache(2014)

7. Interval valued Neutrosophic parameterized soft sets, Broumi, Deli and

Smarandache (2014)

8. Interval valued fuzzy Neutrosophic soft sets,Arockiarani and sumathi(2014)

9.(α, β, γ) – cut fuzzy Neutrosophic soft sets, Arockiarani and sumathi (2014)

10. Neutrosophic soft expert sets, Sahin, Alkhazaleh and Ulucay (2014)

11. Weighted Neutrosophic soft sets, Maji (2015)

12. Intuitionistic fuzzy Neutrosophic soft sets, Saroja and Kalaichelvi (2015)

The main aim of this thesis to study Soft sets, Neutrosophic sets, Neutrosophic soft sets and Fuzzy Neutrosophic soft sets.

The plan of study is as follows:

1. Neutrosophic soft sets
2. Generalized Neutrosophic soft sets
3. Interval valued Neutrosophic soft sets
4. Generalized interval valued Neutrosophic soft sets
5. Neutrosophic parameterized soft sets
6. Possibility Neutrosophic soft sets
7. Intuitionistic Neutrosophic soft sets
8. Intuitionistic fuzzy Neutrosophic soft sets and Intuitionistic fuzzy Neutrosophic soft topological spaces.

The first chapter is devoted to the study of Neutrosophic soft sets. In this chapter preliminary definitions regarding Neutrosophic sets, Soft sets and Neutrosophic soft sets are studied with interesting examples. A relation on Neutrosophic soft sets is defined. Then symmetric, transitive and reflexive Neutrosophic soft relations are examined and many related concepts such as equivalent Neutrosophic soft relation, partition of Neutrosophic soft sets, quotient Neutrosophic soft sets, Neutrosophic soft composition are given and their properties are discussed.

The second chapter deals with preliminary definitions, operations and properties regarding generalized Neutrosophic soft sets. The operations include generalized Neutrosophic soft union, generalized Neutrosophic soft intersection, 'AND' operation and 'OR' operation on generalized Neutrosophic soft sets. The important properties are given in theorems 2.13, 2.14 and 2.17.

In chapter III, the notion of interval valued Neutrosophic soft sets is defined which is a combination of an interval valued Neutrosophic set and a Soft set. Interval valued Neutrosophic soft sets generalizes the concept of the Soft set, fuzzy soft set, interval valued fuzzy soft set, intuitionistic fuzzy soft set, interval valued intuitionistic fuzzy soft set and Neutrosophic soft set. Some definitions and operations on interval valued Neutrosophic soft sets are introduced. Some properties of interval valued Neutrosophic soft sets which are connected to the operations have been established.

The concept of generalized interval valued Neutrosophic soft sets and their properties are presented in chapter IV. The important properties proved here are given in theorems 4.15, 4.16 and 4.19.

In chapter V, the definition of Neutrosophic parameterized soft set is presented with some operations. NP-aggregation operator is defined to form NP-soft decision making method which allows constructing more efficient decision process. Finally, an example is given which shows that they can be successfully applied to problems that contain indeterminacy.

Chapter VI deals with possibility Neutrosophic soft sets. The definition of possibility Neutrosophic soft sets and some operations on possibility Neutrosophic soft sets are given. Properties related to these operations are investigated.

Chapter VII, is devoted to the study of intuitionistic Neutrosophic soft sets which is a combination of intuitionistic Neutrosophic sets and Soft sets. Intuitionistic Neutrosophic soft set theory proposed by Broumi and Samarandache (2013), has been regarded as an effective mathematical tool to deal with uncertainties. In this chapter new operations on intuitionistic Neutrosophic soft sets have been introduced. Some results relating to the properties of these operations have been established.

Chapter VIII deals with intuitionistic fuzzy Neutrosophic soft sets and

intuitionistic fuzzy Neutrosophic soft topological spaces.

In 1965, Zadeh introduced the concept of fuzzy set theory. After then several researchers have extended this concept in many directions. The traditional fuzzy set is characterized by the membership value or the grade of membership value. In some real life problems in expert system, belief system, information fusion and so on, one must consider the truth membership as well as the falsity membership for proper description of an object in uncertain, ambiguous environment. Intuitionistic fuzzy set is appropriate for such a situation and is introduced by Atanassov in 1986.

The topological structures of set theory dealing with uncertainties were first studied by Chang in 1968. Chang introduced the notion of fuzzy topology and also studied some of its basic properties. Shabir and Naz (2011) introduced the notion of the Soft topology and studied some basic concepts such as Soft interior, Soft closure and Soft sub base etc. Fuzzy soft topological spaces are introduced by Tridiv Jyoti Neog et al. (2012). Intuitionistic fuzzy soft topological spaces are introduced by Sadi Bayramov and Gigdemgunduz (2014). Neutrosophic topological spaces are introduced by Salama and Alblowi (2012). Fuzzy Neutrosophic topological spaces and fuzzy Neutrosophic Soft topological spaces are introduced by Arockiarani and Martina Jency (2013).

The author of this thesis introduced the concepts of intuitionistic fuzzy Neutrosophic soft sets and intuitionistic fuzzy Neutrosophic soft topological spaces (2015). In chapter VIII, intuitionistic fuzzy Neutrosophic soft sets and intuitionistic fuzzy Neutrosophic soft topological spaces are studied. Also the concepts of intuitionistic fuzzy Neutrosophic soft closure, intuitionistic fuzzy Neutrosophic soft interior, intuitionistic fuzzy Neutrosophic soft exterior, intuitionistic fuzzy Neutrosophic soft boundary are introduced and some important theorems are established.

Interesting results proved here are given in theorems 8.16, 8.17, 8.19, 8.21, 8.22, 8.24, 8.25, 8.27, 8.29 and 8.30.

It is worth mentioning that the author of this thesis published an article related to intuitionistic fuzzy Neutrosophic Soft sets and intuitionistic fuzzy Neutrosophic soft topological spaces as detailed below:

"Intuitionistic Fuzzy Neutrosophic Soft Topological Spaces", *International Journal of Innovative Research in Science, Engineering and Technology*, Vol.4, Issue 5, May 2015, pp.3338-3345[47].