# REVIEW OF LITERATURE

In 1965, the concept of fuzzy sets was first initiated by Zadeh [43], deal with possibilistic uncertainty, connected with imprecision of states, perceptions and preferences. In 1971, Rosen Feld [36] introduced notion of fuzzy subgroup of a group. Since then, many scholars have studied the theories of fuzzy subgroups of a group. In 1975, Zadeh [44] introduced the concept of an interval valued fuzzy set which is an extension of the concept of fuzzy set. In 1990, R.Biswas [6] introduced the concept of antifuzzy subgroups of groups.

In 1966, Imai and Iseki [14] introduced two classes of abstract algebras : BCK-algebras and BCI-algebras. BCI-algebras as a class of logical algebras are the algebraic formulations of the set difference together with its properties in set theory and the implicational functor in logical systems. It is known that the class of BCK-algebras is a proper subclass of the class of BCI-algebras. In 1983, Q.P.Hu and X.Li [13] introduced a wide class of abstract : BCH-algebras. They have shown that the class of BCI-algebras is a proper subclass of the class of BCH-algebras. In 2007, as a generalization of a BCK/BCI-algebras, Kim and Kim [21] introduced the notion of a BE-algebra which was deeply studied by many mathematicians. As a generalization of BE-algebras and dual BCK/BCI/BCH-algebras in 2010, B.L.Meng [28] introduced the notion of CI-algebras and studied its elementary properties.

In 2011, the concept of fuzzification of ideals in CI-algebra have introduced by Samy M.Mostafa [37] and in (2012) the concept of anti fuzzy ideals in CI-algebras have introduced by Priya T. and Ramachandran, T. [31]

In 1986, the idea of “intuitionistic fuzzy set” was first introduced by Atanassov [2], as a generalization of the notion of fuzzy set. In 2012, by using t-norm T and s-norm S, the notion of intuitionisitc (T, S)-fuzzy subalgebras of CI-algebras and intuitionistic (T, S)-fuzzy closed filters of CI-algebras are introduced by A.Borumand Saeid and A.Rezaei [8].

In 2012, based on the (interval-valued) fuzzy sets, Jun et al. [20] introduced the notion of (internal, external) cubic sets, and investigated several properties. In 2014, the notions of cubic subalgebras and cubic filters in CI-algebras are introduced and studied by Sun Shin Ann, Young Hie Kim and Jung Mi Ko [40].

Several other authors have also contributed to the study of the concepts mentioned above we give here a brief survey of some of the articles published on various algebras and fuzzy algebras.

**1. AN INTRODUCTION TO THE THEORY OF BCK-ALGEBRAS**
**K.Iseki and S.Tanaka [1978] [15]**

In this article, the definition of BCK-algebra and its fundamental properties are studied. Various ideals in BCK-algebras are discussed in a detailed manner. Also, the homomorphism properties on BCK-algebra are discussed.

**2. BCK-ALGEBRA WITH CONDITION(S)**
**K.Iseki [1979] [16]**

In this article, definition and some properties of BCK-algebra with condition(s) are studied. Also, the relationships between this algebra and a positive implicative BCK-algebra are discussed.

**3. ON IDEALS IN BCK-ALGEBRAS**
**J.Meng [1994] [26]**

In this note, various ideals in BCK-algebras are discussed in details. The notion of implicative ideals and commutative ideals are introduced. Their relationships with other ideals are studied. Also the ideal characterization of several important classes of BCK-algebras are given. In particular, distributive theorems of commutative, implicative and positive implicative ideals are obtained.

## 4. INTERVAL-VALUED FUZZY SUBALGEBRAS / IDEALS IN BCK-ALGEBRAS

**Young Bae Jun [2000] [18]**

The notion of an interval-valued fuzzy subalgebra / 0-subalgebra / ideal of a BCK-algebra is defined. The author studied how the homomorphic images and inverse images of i–v fuzzy subalgebras become i–v fuzzy subalgebras. The author gave a condition for an i–v fuzzy set in a BCK-algebra with condition(s) to be an i–v fuzzy ideal. Also the characterizations of an i–v fuzzy subalgebra / ideal are given.

## 5. ON FUZZY IDEALS IN BCK / BCI-ALGEBRAS

**Jie Meng, Xiu-e Guo [2005] [27]**

In this article, the authors proved that the set of all fuzzy ideals in a BCI-algebra forms a complete lattice called fuzzy ideal lattice. Also the authors established the prime fuzzy ideal theorem.

## 6. ON BE-ALGEBRAS

**Hee Sik Kim and Young Hee Kim [2006] [12]**

In this article, as a generalization of a BCK-algebra, the authors introduced the notion of a BE-algebra, and using the notion of upper sets they gave an equivalent condition of the filter in BE-algebras.

## 7. FUZZY SUBALGEBRAS WITH THRESHOLDS IN BCK / BCI-ALGEBRAS

**Y.B.Jun [2007] [19]**

In this article, by using the belong to relation ($\in$) and quasi-coincidence with relation (q) between fuzzy points and fuzzy sets, the concept of ($\alpha$, $\beta$)-fuzzy subalgebras where $\alpha$, $\beta$ are any two $\{\in, q, \in \vee q, \in \wedge q\}$ with $\alpha \neq \in \wedge q$ are introduced, and related properties were investigated. In this article, the notion of a fuzzy subalgebra with thresholds is introduced, and its

characterization are obtained. Relations between a fuzzy subalgebra with thresholds and an $(\in, \in \vee q)$-fuzzy subalgebra are provided by the author.

## 8. INTUITIONISTIC (T ; S)-NORMED FUZZY SUBALGEBRAS OF BCK-ALGEBRAS

**K.H.Kim [2007] [22]**

Using t-norm T and s-norm S, the author introduced the notion of intuitionistic (T ; S)-normed fuzzy subalgebra in BCK / BCI-algebra and some related properties are investigated.

## 9. REDEFINED FUZZY SUBALGEBRAS OF BCK / BCI-ALGEBRAS

**A.Borumand Saeid and Y.B.Jun [2008] [7]**

In this article, using the notion of anti fuzzy points and its besideness to and non quasi-coincidence with a fuzzy set, new concepts in anti-fuzzy subalgebras in BCK / BCI-algebras are introduced and studied their properties.

## 10. INTUITIONISTIC (T, S)-NORMED FUZZY CLOSED IDEALS OF BCH-ALGEBRA

**K.H.Kim [2008] [23]**

The author considered the generalization of the notion of fuzzy subalgebras and closed ideal in BCH-algebras. In this article, using t-norm T and s-norm S, they introduced the notion of intuitionistic (T, S)-normed fuzzy subalgebra and intuitionistic (T, S)-normed fuzzy closed ideal in BCH-algebras, and some related properties are investigated.

## 11. ATOMS IN CI-ALGEBRAS AND SINGULAR CI-ALGEBRAS

**Biao Long Meng [2010] [5]**

In this article, the author introduced the notion of atoms in CI-algebras and investigated its elementary properties. Also the author introduced the

notion of singular CI-algebras and give a number of its properties. Especially, relations between singular CI-algebras and Abelian groups are discussed.

**12. ON CONGRUENCES AND BE-RELATIONS IN BE-ALGEBRAS**
**Yong Ho Yon [2010] [41]**

In this article, a construction of a congruence having a given filter is presented. Also as a generalization of an BE-algebra homomorphism, the notion of a relation on BE-algebra, called an BE-relation is introduced and some fundamental properties to BE-algebras are discussed.

**13. FILTERS IN COMMUTATIVE BE-ALGEBRAS**
**Sun Shin Ahn, Young Hie Kim and Jung Mi Ko [2012] [39]**

In this article, the notions of terminal sections of BE-algebras are introduced. Characterizations of a commutative BE-algebra are provided.

**14. QUOTIENT CI-ALGEBRAS**
**A.Borumand Saeid and A.Rezaei [2012] [10]**

In this article, the author introduced the concept of congruence relation on CI-algebras and the notion of closed filter in CI-algebra. Also the authors constructed quotient algebra via closed filter and investigated related properties.

**15. IDEALS AND FILTERS IN CI-ALGEBRAS BASED ON BIPOLAR-VALUED FUZZY SETS**
**Young Bae Jun, Kyoung Ja Lee, Eun Hwan Roh [2012] [42]**

In this article, the notions of bipolar fuzzy CI-subalgebras, bipolar fuzzy ideals and (closed) bipolar fuzzy filters in CI-algebras are introduced and related properties are investigated. Characterizations of a bipolar fuzzy ideal and a (closed) bipolar fuzzy filter in CI-algebras are established. Relations between a bipolar fuzzy CI-subalgebra and a (closed) bipolar fuzzy filter are

discussed, and conditions for a bipolar fuzzy CI-subalgebra to be a (closed) bipolar fuzzy filter are provided.

## 16. FUZZY CONGRUENCE RELATIONS IN CI-ALGEBRAS

**A.Rezaei, A.Borumand Saeid [2012] [35]**

In this article, the authors introduced the notion of fuzzy filters (ideals) in CI-algebras. The authors studied fuzzy congruence relation in detail and constructed quotient algebras via a fuzzy congruence relation on CI-algebra X.

## 17. $\mathcal{N}$-SUBALGEBRAS AND $\mathcal{N}$-FILTERS IN CI-ALGEBRAS

**A.Rezaei and A.Borumand Saeid [2012] [34]**

In this article, the author introduced the notions of $\mathcal{N}$-subalgebras and $\mathcal{N}$–filters in CI-algebras and gave a number of their properties. The relationships between $\mathcal{N}$–subalgebras and $\mathcal{N}$–filters are also investigated.

## 18. CUBIC SETS

**Jun, Y.B., Kim, C.S., and Yang, K.O. [2012] [20]**

The notions of (internal, external) cubic sets, P-(R-) order, P-(R-) union and P-(R-) intersection are introduced, and related properties are investigated. The authors showed that the P-union and the P-intersection of internal cubic sets are also internal cubic sets. They provided examples to show that the P-union and the P-intersection of external cubic sets need not be external cubic sets, and the R-union and the R-intersection of internal (resp. external) cubic sets need not be internal (resp. external) cubic sets. They provided conditions for the P-union (resp. P-intersection) of two external cubic sets to be an internal cubic set. They also gave conditions for the P-union (resp. R-union and R-intersection) of two external cubic sets to be an external cubic set. They considered conditions for the R-intersection (resp. P-intersection) of two cubic sets to be both an external cubic set and an internal cubic set.

## 19. INTUITIONISTIC FUZZY H-IDEALS OF BCI-ALGEBRAS WITH INTERVAL VALUED MEMBERSHIP AND NON MEMBERSHIP FUNCTIONS

**N.Palaniappan, P.S.Veerappan and R.Devi [2012] [30]**

In this article, the purpose is to define the notion of an interval valued intuitionistic fuzzy H-ideal of a BCI-algebra. Necessary and sufficient conditions for an i-v intuitionistic fuzzy H-ideal are stated by the authors and Cartesian products of i-v intuitionistic fuzzy ideals are discussed.

## 20. ANOTHER GENERALIZATION OF FUZZY BCK / BCI-ALGEBRAS

**A.Borumand Saeid, M.Kuchaki Rafsanjani and D.R.Prince Williams [2012] [9]**

In this article a new generalization of the fuzzy BCK / BCI-algebras of type $(\alpha, \beta)$ are introduced by the authors. Then they have stated and proved some theorems which determine the relationship between these notions and subalgebras of BCK / BCI-algebras. Characterizations of $(\alpha, \beta)$-interval valued fuzzy subalgebras in BCK / BCI-algebras are given.

## 21. ON PSEUDO BE-ALGEBRAS

**Rajab Ali Borzooei [2013] [33]**

In this article, the author introduced the notion of pseudo BE-algebra which is a generalization of BE-algebra. They defined the concepts of pseudo subalgebras and pseudo filters and proved that, under some conditions, pseudo subalgebra can be a pseudo filter. They proved that every homomorphic image and pre-image of a pseudo filter is also a Pseudo filter. Furthermore, the notion of pseudo upper sets in pseudo BE-algebras are introduced. The author proved that every pseudo filter is an union of pseudo upper sets.

## 22. UNION-SOFT FILTERS OF CI-ALGEBRS

**Kyoung Ja Lee [2013] [25]**

In this article, the notion of union-soft filters of a CI-algebra is introduced, and related properties are investigated. Characterization of a union-soft filter is discussed and conditions for a soft set to be a union-soft filter are provided.

## 23. COMMUTATIVE AND BOUNDED BE-ALGEBRAS

**Zekiye Ciloglu and Yilmaz Ceven [2013] [45]**

In this article, the authors introduced the notion of bounded BE-algebras and investigated some properties of them.

## 24. SOME PROPERTIES OF $(\in_y, \in_y \vee q\xi)$-FUZZY SUB COMMUTATIVE IDEALS IN BCI-ALGEBRAS

**Muhammad Zulfiqar and Muhammad Shabir [2013] [29]**

In this article, the authors introduced the concepts of $(\in_y, \in_y \vee q\xi)$-fuzzy subcommutative ideal and $(\overline{\in}_y, \overline{\in}_y \vee \overline{q}\,\xi)$-fuzzy subcommutative ideal in BCI-algebra and investigated some of their related properties.

## 25. HYPER BE-ALGEBRAS

**A.Radfar, A.Rezaei and A.Borumand Series [2014] [32]**

In this article, the authors introduced the notion of hyper BE-algebra and investigated some properties. Also, some types of hyper filters in hyper BE-algebras are studied and the relationship between them are stated.