

# Some Basic Properties of Weakly Completely Primary Ideals in $\Gamma$ -Near Rings

Pairote Yiarayong<sup>1</sup> and Phakakorn Panpho<sup>2</sup>

<sup>1</sup> Department of Mathematics, Faculty of Science and Technology,  
Pibulsongkram Rajabhat University, Phitsanuloke 65000, Thailand  
E-mail: pairote0027@hotmail.com

<sup>2</sup> Faculty of Science and Technology, Pibulsongkram Rajabhat University,  
Phitsanuloke 65000, Thailand  
E-mail: kpanpho@hotmail.com

---

**ABSTRACT**— *In this paper, we study completely primary and weakly completely primary ideals in  $\Gamma$ -near-rings. Some characterizations of completely primary and weakly completely primary ideals are obtained. Moreover, we investigate relationships completely primary and weakly completely primary ideals in  $\Gamma$ -near rings. Finally, we obtain necessary and sufficient conditions of a weakly completely primary ideal to be a completely primary ideals in  $\Gamma$ -near rings.*

**Keywords**—  $\Gamma$ -near-ring, completely primary, weakly completely primary, quasi completely weakly primary, quasi completely primary.

---

## 1. INTRODUCTION

Throughout this paper, by a  $\Gamma$ -near-ring  $N$  we always mean a zero-symmetric near-ring with identity 1. For basic definitions in near-rings one may refer [20]. In 1970 W. L. M. Holcombe was introducing the notions of (0, 1, 2)-prime ideals of a near ring. In 1977 G. Pilz, was introducing the notion of prime ideals of a near ring. In 1988 N.J.Groenewald was introducing the notions of completely (semi) prime ideals of a near ring. In 1991 N.J.Groenewald was introducing the notions of 3-(semi) prime ideals of a near ring. In 2003 D. D. Anderson and E. Smith defined weakly prime ideals in commutative rings, an ideal  $P$  of a ring  $R$  is weakly prime if  $0 \neq ab \in P$  implies  $a \in P$  or  $b \in P$ .

The concept of  $\Gamma$ -near ring, a generalization of both the concepts near-ring and  $\Gamma$ -ring was introduced by Satyanarayana [21]. Later, several authors such as Booth and Booth, Groenewald [4, 5, 6] studied the ideal theory of  $\Gamma$ -near rings. Groenewald [12] introduced semi uniformly strongly prime near-rings.

In this paper we study completely primary and weakly completely primary ideals in  $\Gamma$ -near-rings. Some characterizations of completely primary and weakly completely primary ideals are obtained. Moreover, we investigate relationships completely primary and weakly completely primary ideals in  $\Gamma$ -near rings. Finally, we obtain necessary and sufficient conditions of a weakly completely primary ideal to be a completely primary ideals in  $\Gamma$ -near rings.

## 2. BASIC RESULTS

In this section we refer to [24, 25] for some elementary aspects and quote few theorem and lemmas which are essential to step up this study. For more details we refer to the papers in the references.

**Definition 2.1.** [25] All near-rings considered in this paper are left distributive. A  $\Gamma$ -near-ring is a triple  $(N, \Gamma, +)$ , where

(i)  $(N, +)$  is a group (not necessarily abelian);

(ii)  $\Gamma$  is a non-empty set of binary operations on  $N$  such that for each  $\gamma \in \Gamma$ ,  $(N, +, \gamma)$  is a right near -ring and;

(iii)  $(a\gamma b)\alpha c = a\gamma(b\alpha c)$ , for all  $a, b, c \in N$  and  $\gamma, \alpha \in \Gamma$ .

$\Gamma$ -near rings generalize near-rings in the sense that every near-ring  $N$  is a  $\Gamma$ -near ring, with  $\Gamma = \{\cdot\}$ , where  $\cdot$  is the multiplication defined on  $N$ .

**Definition 2.2.** [25] Let  $N$  be a  $\Gamma$ -near ring, then a normal subgroup  $A$  of  $(N, \Gamma, +)$  is said to be

- (i) left ideal if  $m\gamma(n + a) - m\gamma n \in A$ , for all  $a \in A, \gamma \in \Gamma$ , and  $m, n \in N$ ;
- (ii) right ideal if  $a\gamma n \in A$ , for all  $a \in A, \gamma \in \Gamma$ , and  $n \in N$ ;
- (iii) ideal if it is both left and right ideal of  $N$ .

If  $A$  is an ideal of  $N$ , then it is denoted by  $A \triangleleft N$ . The ideal generated by  $a \in N$ , is denoted by  $\langle a \rangle$ .

**Lemma 2.3.** [25] Let  $A$  be a left ideal of a  $\Gamma$ -near ring  $N$ . Then  $(A : n)_\gamma$  is a left ideal of  $N$ , where  $(A : n)_\gamma = \{m \in N : m\gamma n \in A\}$ .

**Lemma 2.4.** Let  $A$  be an ideal of  $(N, +, \cdot)$ . Then is a  $\Gamma$ -near-ring under the operations: For all  $a, b \in N$

$$(a + A) + (b + N) = (a + b) + A \text{ and } (a + A)(b + N) = (ab) + A.$$

**Lemma 2.5.** Let  $A$  and  $B$  be ideals of  $(N, \Gamma, +)$ . Then  $(A + B) / A \approx B / (A \cap B)$ . Furthermore, if  $A \subseteq B$ , then  $(N / A) / (B / A) \approx N / B$ .

**Definition 2.6.** Let  $(N, \Gamma, +)$  be a  $\Gamma$ -near-ring and  $A$  be a subset of  $N$ . We write

$$\sqrt{A} = \{a \in N : a^k \in A \text{ for some positive integer } k\}.$$

**Definition 2.7.** A ideal  $P$  of a  $\Gamma$ -near-ring  $N$  is called a completely primary ideal if for  $a, b \in N$  and  $\gamma \in \Gamma$  such that  $a\gamma b \in P$  implies that  $a^n \in P$  or  $b \in P$ , for some positive integer  $n$ .

**Definition 2.8.** A ideal  $P$  of a  $\Gamma$ -near-ring  $N$  is called a weakly completely primary ideal if for  $a, b \in N$  and  $\gamma \in \Gamma$  such that  $0 \neq a\gamma b \in P$  implies that  $a^n \in P$  or  $b \in P$ , for some positive integer  $n$ .

Clearly every completely primary ideal is weakly completely primary and  $\{0\}$  is always weakly completely primary ideal of  $N$ . The following example shows that a weakly completely primary ideal need not be a completely primary ideal in general.

**Example 2.9.** Let  $N = \{0, a, b, c, d, 1, 2, 3\}$  and  $\Gamma = \{0, 1\}$ . Define addition and multiplication in  $N$  as follows:

+	0	1	2	3	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
0	0	1	2	3	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1	1	2	3	0	<i>d</i>	<i>c</i>	<i>a</i>	<i>b</i>
2	2	3	0	1	<i>b</i>	<i>a</i>	<i>d</i>	<i>c</i>
3	3	0	1	2	<i>c</i>	<i>d</i>	<i>b</i>	<i>a</i>
<i>a</i>	<i>a</i>	<i>d</i>	<i>b</i>	<i>c</i>	2	0	1	3
<i>b</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>d</i>	0	2	3	1
<i>c</i>	<i>c</i>	<i>a</i>	<i>d</i>	<i>b</i>	1	3	0	2
<i>d</i>	<i>d</i>	<i>b</i>	<i>c</i>	<i>a</i>	3	1	2	0

·	0	1	2	3	a	b	c	d
0	0	0	0	0	0	0	0	0
1	0	1	2	3	a	b	c	d
2	0	2	0	2	2	2	0	0
3	0	3	2	1	b	a	c	d
a	0	a	2	b	a	b	c	d
b	0	b	2	a	b	a	c	d
c	0	c	0	c	0	0	0	0
d	0	d	0	d	2	2	0	0

Then  $(N, +, \cdot)$  is a  $\Gamma$ -near ring. Here  $\{0, c\}$  is a weakly completely primary ideal, but not a completely primary, since  $2 \cdot \gamma \cdot 2 = 0 \in \{0, c\}$ .

### 3. MAIN RESULTS

We start with the following theorem that gives a relation between weakly completely primary and completely primary ideals in a  $\Gamma$ -near-ring. Our starting points is the following lemma:

**Lemma 3.1.** If  $N$  is a  $\Gamma$ -near-ring with identity, then  $a\gamma b = a\alpha b$  for all  $a, b \in N$  and  $\gamma, \alpha \in \Gamma$ .

**Proof.** Let  $N$  be a  $\Gamma$ -near-ring and  $e$  be the identity of  $N$ , and let  $a, b \in N, \gamma, \alpha \in \Gamma$  therefore we have

$$\begin{aligned} a\gamma b &= a\gamma(eab) \\ &= (a\gamma e)ab \\ &= a\alpha b. \end{aligned}$$

Hence  $a\gamma b = a\alpha b$ .

**Lemma 3.2.** Let  $N$  be a  $\Gamma$ -near-ring, and let  $A$  be a left ideal of  $N$ . Then  $(A : \Gamma : B)$  is a left ideal in  $N$ , where  $(A : \Gamma : B) = \{n \in N : n\Gamma B \subseteq A\}$ .

**Proof.** Let  $N$  be a  $\Gamma$ -near-ring, and let  $A$  be a left ideal of  $N$ . Suppose that  $n \in N$  and  $m, n \in (A : \Gamma : B)$ . Then  $m\Gamma B \subseteq A$  and  $n\Gamma B \subseteq A$  so that

$$(n - m)\Gamma B = n\Gamma B - m\Gamma B \subseteq A.$$

Therefore  $n - m \in (A : \Gamma : B)$ . For  $a \in (A : \Gamma : B)$  and  $n \in N$ ,

$$\begin{aligned} (n + a - n)\Gamma B &= n\Gamma B + a\Gamma B - n\Gamma B \\ &\subseteq n\Gamma B + A - n\Gamma B \\ &\subseteq A \end{aligned}$$

since  $A$  is a left ideal of  $N$ . Therefore,  $n + a - n \in (A : \Gamma : B)$ . Thus  $(A : \Gamma : B)$  is a normal subgroup of  $N$ . Let  $m, n \in N, a \in (A : \Gamma : B)$  and  $\beta, \gamma \in \Gamma$ . Then

$$\begin{aligned} (m\gamma(n - a) - m\gamma n)\Gamma B &= (m\gamma(n - a))\Gamma B - (m\gamma n)\Gamma B \\ &= m\gamma((n - a)\Gamma B) - (m\gamma n)\Gamma B \\ &= m\gamma(n\Gamma B - a\Gamma B) - (m\gamma n)\Gamma B \\ &= m\gamma(n\Gamma B - a\Gamma B) - (m\gamma n)\Gamma B \\ &\subseteq A. \end{aligned}$$

Thus  $m\gamma(n - a) - m\gamma n \in (A : \Gamma : B)$ . Hence  $(A : \Gamma : B)$  is a left ideal in  $N$ .

**Theorem 3.3.** Let  $N$  be a  $\Gamma$ -near-ring, and let  $A$  be an ideal of  $N$ . If  $A$  is a weakly quasi completely primary (quasi completely primary) ideal of  $N$ , then  $(A : \Gamma : B)$  is a weakly quasi completely primary (quasi completely primary) ideal in  $N$ , where  $B \not\subseteq A$ .

**Proof.** Let  $N$  be a  $\Gamma$ -near-ring, and let  $A$  be a weakly completely quasi primary ideal of  $N$ . Suppose that  $0 \neq myn \in (A : \Gamma : B)$  and  $m^k \notin (A : \Gamma : B)$ , for all positive integer  $k$ . Then

$$0 \neq m\gamma(n\Gamma B) = (m\gamma n)\Gamma B \subseteq A.$$

By Definition of weakly quasi completely primary ideal, we get  $m^k \in A$  or  $n\Gamma B \subseteq A$  for some positive integer  $k$  so that  $n \in (A : \Gamma : B)$ . Hence  $(A : \Gamma : B)$  is a weakly quasi completely primary ideal in  $N$ .

**Corollary 3.4.** Let  $N$  be a  $\Gamma$ -near-ring, and let  $A$  be a weakly quasi completely primary (quasi completely primary) ideal of  $N$ . Then  $(A : m)_\gamma$  is a weakly quasi completely primary (quasi completely primary) ideal in  $N$ , where  $m \in N - A$ .

**Proof.** This follows from Theorem 3.3.

**Theorem 3.5.** Let  $N$  be a  $\Gamma$ -near-ring, and let  $P$  be an ideal of  $N$ . If  $P$  is a weakly completely primary ideal that is not completely primary. Then  $\sqrt{P} = \sqrt{0}$ .

**Proof.** Let  $N$  be a  $\Gamma$ -near-ring with identity. First, we prove that  $P^2 = 0$ . Suppose that  $P^2 \neq 0$  we show that  $P$  is weakly completely primary. Let  $a\gamma b \in P$ , where  $a, b \in N, \gamma \in \Gamma$ . If  $a\gamma b \neq 0$ , then either

$$a \in \sqrt{P} \text{ or } b \in P$$

since  $P$  is weakly completely primary ideal. So suppose that  $a\gamma b = 0$ . If  $P\gamma b \neq 0$ , then there is an element  $p'$  of  $P$  such that  $p'\gamma b \neq 0$ , so that

$$0 \neq p'\gamma b = (p' + a)\gamma b \in P,$$

and hence  $P$  weakly completely primary ideal gives either  $p' + a \in \sqrt{P}$  or  $b \in P$ . As  $p' + a \in \sqrt{P}$  and  $p' \in P \subseteq \sqrt{P}$  we have either  $a \in \sqrt{P}$  or  $b \in P$ . So we can assume that  $P\gamma b = 0$ . Similarly, we can assume that  $P\gamma a = 0$ . Since  $P^2 \neq 0$ , there exist  $c, d \in P$  such that  $c\gamma d \neq 0$ . Then

$$(a + c)\gamma(b + d) \in P,$$

so either  $p + c \in P$  or  $q + d \in \sqrt{P}$ , and hence either  $p \in P$  or  $q \in \sqrt{P}$ . Thus  $P$  is completely primary ideal.

Clearly,  $\sqrt{0} \subseteq \sqrt{P}$ . As  $P^2 = 0$ , we get  $\sqrt{P} \subseteq \sqrt{0}$ , hence  $\sqrt{P} = \sqrt{0}$ , as required.

**Corollary 3.6.** Let  $N$  be a  $\Gamma$ -near-ring, and let  $P$  an ideal of  $N$ . If  $\sqrt{P} \neq \sqrt{0}$ , then  $P$  is completely primary if and only if  $P$  is weakly completely primary.

**Proof.** This follows from Theorem 3.5.

**Lemma 3.7.** Let  $N$  be a  $\Gamma$ -near-ring with identity, and let  $P$  be a proper ideal of  $N$ . If  $P$  is a weakly completely primary ideal of  $N$ , then  $(P : \Gamma : N\Gamma a) = P \cup (0 : \Gamma : N\Gamma a)$ , where  $a \in N - \sqrt{P}$ .

**Proof.** Let  $N$  be a  $\Gamma$ -near-ring with identity, and let  $P$  be a weakly completely primary ideal of  $N$ . Clearly,

$$P \cup (0 : \Gamma : N\Gamma a) \subseteq (P : \Gamma : N\Gamma a).$$

For the other inclusion, suppose that  $m \in (P : \Gamma : N\Gamma a)$ , so that

$$m\Gamma(N\Gamma a) \subseteq P.$$

If  $0 \neq m\Gamma(N\Gamma a)$ , then  $N\Gamma a \subseteq P$  since  $P$  is weakly completely primary. If  $0 = m\Gamma(N\Gamma a)$ , then  $m \in (0 : \Gamma : N\Gamma a)$  so we have the equality.

**Corollary 3.8.** Let  $N$  be a  $\Gamma$ -near-ring with identity, and let  $P$  be a proper ideal of  $N$ . If  $P$  is a weakly completely primary ideal of  $N$ , then  $(P : \Gamma : a) = P \cup (0 : \Gamma : a)$ , where  $a \in N - \sqrt{P}$ .

**Proof.** This follows from Lemma 3.7.

**Corollary 3.9.** Let  $N$  be a  $\Gamma$ -near-ring with identity, and let  $P$  be a proper ideal of  $N$ . If  $(P : \Gamma : N\Gamma a) = P \cup (0 : \Gamma : N\Gamma a)$ , then  $(P : \Gamma : N\Gamma a) = P$  or  $(P : \Gamma : N\Gamma a) = (0 : \Gamma : N\Gamma a)$ , where  $a \in N - \sqrt{P}$ .

**Proof.** This follows from Lemma 3.7.

**Theorem 3.10.** Let  $N$  be a  $\Gamma$ -near-ring with identity, and let  $P$  be a proper ideal of  $N$ . If  $(P : \Gamma : n) = P$  or  $(P : \Gamma : n) = (0 : \Gamma : n)$ , then  $P$  is a weakly completely primary ideal of  $N$ , where  $n \in N - \sqrt{P}$ .

**Proof.** Let  $N$  be a  $\Gamma$ -near-ring with identity, and let  $P$  be a proper ideal of  $N$ . Suppose that Let  $0 \neq m\gamma n \in P$ , where  $m \in N - \sqrt{P}, \gamma \in \Gamma$ . Then

$$m \in (P : \Gamma : n) = P \cup (0 : \Gamma : n)$$

by Corollary 3.9 hence  $m \in P$  since  $m\gamma n \neq 0$ , as required.

**Lemma 3.11.** Let  $N = N_1 \times N_2$ , where each  $N_i$  is a  $\Gamma$ -near-ring with identity. Then the following hold:

- (i) If  $A$  is an ideal of  $N_1$ , then  $\sqrt{A \times N_2} = \sqrt{A} \times N_2$ .
- (ii) If  $A$  is an ideal of  $N_2$ , then  $\sqrt{N_1 \times A} = N_1 \times \sqrt{A}$ .

**Proof.** The proof is straightforward.

**Theorem 3.12.** Let  $N = N_1 \times N_2$ , where each  $N_i$  is a  $\Gamma$ -near-ring with identity. If  $P$  is a weakly completely primary (completely primary) ideal of  $N_1$ , then  $P \times N_2$  is a weakly completely primary (completely primary) ideal of  $N$ .

**Proof.** Suppose that  $N = N_1 \times N_2$ , where each  $N_i$  is a  $\Gamma$ -near-ring with identity and  $P$  is a weakly completely primary ideal of  $N_1$ . Let

$$0 \neq (a, b)\gamma(c, d) = (a\gamma c, b\gamma d) \in P \times N_2,$$

where  $(a, b), (c, d) \in N, \gamma \in \Gamma$  so either  $a \in \sqrt{P}$  or  $c \in P$  since  $P$  is weakly completely primary. It follows that either

$$(a, b) \in \sqrt{P} \times N_2 = \sqrt{P \times N_2} \text{ or } (c, d) \in P \times N_2.$$

By Definition of weakly completely primary ideal, we have  $P \times N_2$  is a weakly completely primary ideal of  $N$ .

**Corollary 3.13.** Let  $N = N_1 \times N_2$ , where each  $N_i$  is a  $\Gamma$ -near-ring with identity. If  $P$  is a weakly completely primary (completely primary) ideal of  $N_2$ , then  $N_1 \times P$  is a weakly completely primary (completely primary) ideal of  $N$ .

**Proof.** This follows from Lemma 3.12.

**Corollary 3.14.** Let  $N = \prod_{i=1}^n N_i$ , where each  $N_i$  is a  $\Gamma$ -near-ring with identity. If  $P$  is a weakly completely primary (completely primary) ideal of  $N_j$ , then  $N_1 \times N_2 \times \dots \times P_j \times N_{j+1} \times \dots \times N_n$  is a weakly completely primary (completely primary) ideal of  $N$ .

**Proof.** This follows from Theorem 3.12 and Corollary 3.13.

**Theorem 3.15.** Let  $N = N_1 \times N_2$ , where each  $N_i$  is a  $\Gamma$ -near-ring with identity. If  $P$  is a weakly completely primary ideal of  $N$ , then either  $P = 0$  or  $P$  is completely primary.

**Proof.** Let  $N = N_1 \times N_2$ , where each  $N_i$  is a  $\Gamma$ -near-ring with identity and let  $P = P_1 \times N_2$  be a weakly completely primary ideal of  $N$ . We can assume that  $P \neq 0$ . So there is an element  $(a, b)$  of  $P$  with  $(a, b) \neq (0, 0)$ . Then  $(0, 0) \neq (a, 1)\gamma(1, b) \in P$ ,

where  $\gamma \in \Gamma$ , gives either

$$(a, 1) \in \sqrt{P} \text{ or } (1, b) \in \sqrt{P} = \sqrt{P_1} \times N_2.$$

If  $(a, 1) \in P$ , then  $P = P_1 \times N_2$ . We show that  $P_1$  is completely primary hence  $P$  is weakly completely primary by Theorem 3.12. Let  $c\gamma d \in P_1$ , where  $c, d \in N_1$ . Then

$$(0, 0) \neq (c, 1)\gamma(d, 1) = (c\gamma d, 1) \in P,$$

so either  $(c, 1) \in P$  or  $(d, 1) \in \sqrt{P} = \sqrt{P_1} \times N_2$  and hence either  $c \in P_1$  or  $d \in P_1$ . By a similar argument,  $N_1 \times P_2$  is completely primary.

**Proposition 3.16.** Let  $A \subseteq P$  be proper ideals of a  $\Gamma$ -near-ring  $N$ . Then the following hold:

(i) If  $P$  is weakly completely primary (completely primary), then  $P/A$  is weakly completely primary (completely primary).

(ii) If  $A$  and  $P/A$  are weakly completely primary (completely primary), then  $P$  is weakly completely primary (completely primary).

**Proof.** (i) Let  $0 \neq (a + A)\gamma(b + A) = a\gamma b + A \in P/A$ , where  $a, b \in N, \gamma \in \Gamma$  so  $ab \in P$ . If  $a\gamma b = 0 \in A$ , then  $(a + A)\gamma(b + A) = 0$ , a contradiction. So if  $P$  is weakly completely primary, then either  $a \in P$  or  $b \in \sqrt{P}$ , hence either  $a + A \in P/A$  or  $b + A \in \sqrt{P/A}$ , as required.

(ii) Let  $0 \neq a\gamma b \in P$ , where  $a, b \in N$ , so  $(a + A)\gamma(b + A) \in P/A$ . For  $a\gamma b \in A$ , if  $A$  is weakly completely primary, then either  $a \in A \subseteq P$  or  $b \in A \subseteq P \subseteq \sqrt{P}$ . So we may assume that  $a\gamma b \notin A$ . Then either  $a + A \in P/A$  or  $b + A \in \sqrt{P/A}$ . It follows that either  $a \in P$  or  $b \in \sqrt{P}$  as needed.

**Theorem 3.17.** Let  $P$  and  $Q$  be weakly completely primary ideals of a  $\Gamma$ -near-ring  $N$  that are not completely primary. Then  $P + Q$  is a weakly completely primary ideal of  $N$ .

**Proof.** Since  $(P + Q)/Q \approx Q/(P \cap Q)$ , we get that  $(P + Q)/Q$  is weakly completely primary by Proposition 3.16 (i). Now the assertion follows from Proposition 3.16 (ii).

### ACKNOWLEDGEMENT

The authors are very grateful to the anonymous referee for stimulating comments and improving presentation of the paper.

## REFERENCES

- [1] Abbass H.H., Ibrahem S.M., “On fuzzy completely semi prime ideal with respect to an element of a near ring”, Msc thesis, 2011.
- [2] Asci M. “ $\Gamma - (\sigma, \tau)$ -Derivation on Gamma near-rings”, International Mathematical Forum, vol. 2, no. 3, pp. 97-102, 2007.
- [3] Anderson D.D., Smith E. “Weakly prime ideals”, Houston J. Math., vol. 29, no. 4, pp. 831-840, 2003.
- [4] Booth G.L. “A note on Gamma near-rings”, Stud. Sci.Math. Hungarica, vol. 23, pp. 471-475, 1988.
- [5] Booth G.L. “Radicals of  $\Gamma$ -near-rings”, Publ. Math. Debrecen, vol. 39, pp. 223–230, 1990.
- [6] Booth G.L., Groenewald N.J. “On strongly prime near-rings”, Indian J. Math., vol. 40, no. 2, pp. 113–121, 1998.
- [7] Booth G.L., Groenewald N.J. and Veldsman S. “A kurosh-amitsur prime radical for near-rings”, Comm. Algebra, vol. 18, no. 9, pp. 3111-3122, 1990.
- [8] Cho Y.U. “Some results on gamma near-rings”, Journal of the Chungcheong Mathatical society, vol. 19, no. 3, pp. 225-229, 2006.
- [9] Dheena P., Elavarasan B. “Weakly prime ideals in near-rings”, Tamsui Oxford Journal of Information and Mathematical Sciences, vol. 29, no. 1, pp. 55-59, 2013.
- [10] Gardner B.J., Wiegandt R. “Radical theory of rings”, Marcel Dekker, New York – Basel, 2004.
- [11] Groenewald N.J. “Different prime ideals in near-rings”, Comm. Algebra, vol. 19, no. 10, pp. 2667-2675, 1991.
- [12] Groenewald N.J. “Semi-uniformly strongly prime near-rings”, Indian J. Math., vol. 45, no. 3, pp. 241–250, 2003.
- [13] Groenewald N.J. “The completely prime radical in near rings”, Acta Math. Hung., vol. 33, pp. 301-305.
- [14] Holcombe W.L.M. “Primitive near-rings”, Doctoral Dissertation, University of Leeds. 1970.
- [15] Jun Y.B., Kim K.H., Cho Y.U. “On Gamma-derivations in Gamma-near-rings”, Soochow Journal of Mathematics, vol. 29, no. 3, pp. 275-282, 2003.
- [16] Meldrum J.D.P. “Near-rings and their links with groups”, Research notes in Math. Pitman London, 134. 1987.
- [17] Mustafa H.J., Husain Hassan A.M. “Near prime spectrum”. Journal of Kufa for Mathematics and Computer, vol. 1, no. 8, pp. 58-70, 2013.
- [18] Palaniappan N., Veerappan P.S., Ezhilmaran D. “A note on characterization of intuitionistic fuzzy ideals in  $\Gamma$ -near-rings”, International Journal of Computational Science and Mathematics, vol. 3, no. 1, pp. 61-71, 2011.
- [19] Palaniappan N., Veerappan P.S., Ezhilmaran D. “On intuitionistic fuzzy ideals in  $\Gamma$ -near-rings”, NIFS, vol. 17, no. 3, pp. 15-24, 2011.
- [20] Pilz G., “Near -ring”, North Holland Mathematic studies, 23, 1977.
- [21] Satyanarayna Bhavanari “Contributions to near-rings, Doctoral Thesis, Nagarjuna University. 1984.
- [22] Selvaraj C. “On semi uniformly strongly prime  $\Gamma$ -near rings”, Southeast Asian Bulletin of Mathematics, vol. 35, pp. 1015-1028, 2011.
- [23] Selvaral C., R. George R. “On strongly prime  $\Gamma$ -near -rings”, Tamkang Journal of Mathematics, vol. 39, no. 1, pp. 33-43, 2008.
- [24] Selvaral C., R. George R., Booth G.L. “On strongly equiprime  $\Gamma$ -near-rings”, Bulletin of the Institute of Mathematics Academia Sinica, vol. 4, no. 1, pp. 35-46, 2009.
- [25] Selvaraj C., Madhuchelvi L. “On strongly prime spectrum of  $\Gamma$ -near-rings”, Bulletin of the Institute of Mathematics Academia, vol. 6, no. 3, 329-345, 2011.
- [26] Shang Y., “A study of derivations in prime near-rings”, Mathematica Balkanica (New Series), vol. 25, no. 4, 413-418, 2011.
- [27] Shang Y., “On the ideals of commutative local rings”, Kochi Journal of Mathematics, vol.8, 13-17, 2013.