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Γ-SEMI NORMAL SUB NEAR-FIELD SPACES OF A Γ-NEAR-FIELD SPACE OVER NEAR-FIELD PART III

Dr. N. V. NAGENDRAM

Professor of Mathematics,
Kakinada Institute of Technology & Science (K.I.T.S.),
Department of Humanities & Science (Mathematics), Tirupathi (Vill.) Peddapuram (M),
Divili 533 433, East Godavari District. Andhra Pradesh. INDIA.

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ABSTRACT

In this paper, I Dr N V Nagendram as an author in depth study it makes me to study and introduce the Gamma-semi normal sub near-field spaces in Γ-near-field space over a near-field PART III, and also Dr. N V Nagendram investigate the related properties, results of generalization of a Gamma-semi normal sub near-field spaces in Γ-near-field space over a near-field.

Keywords: *Γ-near-field space; Γ-Semi normal sub near-field space of Γ-near-field space; Semi near-field space of Γ-near-field space.*

2000 Mathematics Subject Classification: *43A10, 46B28, 46H25,6H99, 46L10, 46M20, 51 M 10, 51 F 15,03 B 30.*

SECTION-1: INTRODUCTION

In this paper, Part III consisting important two sections I introduce the Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field, and Dr. N V Nagendram being an author investigate the related properties of generalization of and derived results on a Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field.

As a generalization of a Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field, introduced the notion of Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field, extended many classical notions of Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field. In this paper, I develop the algebraic theory of Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field.

The notion of a Γ- semi normal sub near-field spaces in Γ-near-field space over a near-field is introduced and some examples are given. Further the terms; commutative Γ-semi normal sub near-field spaces in Γ-near-field space, quasi commutative Γ-semi normal sub near-field spaces in Γ-near-field space, normal Γ-semi normal sub near-field spaces in Γ-near-field space, left pseudo commutative Γ-semi normal sub near-field spaces in Γ-near-field space, right pseudo commutative Γ-semi normal sub near-field spaces in Γ-near-field space are introduced. It is proved that (1) if S is a commutative Γ-semi normal sub near-field spaces in Γ-near-field space then S is a quasi commutative Γ-semi normal sub near-field spaces in Γ-near-field space, (2) if S is a quasi commutative Γ-semi normal sub near-field spaces in Γ-near-field space then S is a normal Gamma-semi normal sub near-field spaces in Γ-near-field space, (3) if S is a commutative Γ-semi normal sub near-field spaces in Γ-near-field space, then S is both a left pseudo commutative and a right pseudo commutative Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field. Further the terms; left identity, right identity, identity, left zero, right zero, zero of a Gamma-semi normal sub near-field spaces in Γ-near-field space over a near-field are introduced. It is proved that if a is a left identity and b is a right identity of a Γ-semi normal sub near-field spaces in Γ-near-field space, then a = b. It is also proved that any Γ-semi normal sub near-field spaces in Γ-near-field space has at most one identity. It is proved that if a is a left zero and b is a right zero of a Γ-semi normal sub near-field spaces in Γ-near-field space, then a = b and also it is proved that any Γ-semi normal sub near-field spaces in Γ-near-field space over a near-field has at most one zero element.

Corresponding Author: Dr. N. V. Nagendram,
Professor of Mathematics, Kakinada Institute of Technology & Science, Tirupathi (v),
Peddapuram(M), Divili 533 433, East Godavari District, Andhra Pradesh. India.

SECTION-2: RESULTS ON SEMI NORMAL SUB NEAR-FIELD SPACES IN Γ-NEAR-FIELD SPACE OVER A NEAR-FIELD

In this section, we now introduce α-idempotent element and Γ-idempotent element in a Γ- Γ-semi sub near-field space. the terms α-idempotent, Γ-idempotent, strongly idempotent, mid unit, *r*-element, regular element, left regular element, right regular element, completely regular element, (α, β)-inverse of an element, semi simple element and intra regular element in a Γ-semi sub near-field space are introduced. Further the terms, idempotent Γ-semi sub near-field space and generalized commutative Γ-semi normal sub near-field space are introduced. It is proved that every generalized commutative Γ-semi normal sub near-field space is a left duo Γ-semi normal sub near-field space. It is proved that every Γ -idempotent element of a Γ-semi normal sub near-field space is regular near-field space. It is proved that every Γ- sub near-field space of a regular near-field space Γ -semi normal sub near-field space T is a regular near-field space Γ-semi normal sub near-field space of T. It is proved that a Γ-semi normal sub near-field space T is regular near-field space Γ-semi normal sub near-field space if and only if every principal Γ- sub near-field space is generated by an idempotent. Further it is also proved that, in a Γ-semi normal sub near-field space, α is a regular element if and only if α has an (α, β)-inverse. It is proved that, (1) if α is a completely regular element of a Γ- semi normal sub near-field space then α is both left regular and right regular near field space, (2) if 'α' is a completely regular element of a Γ-semi normal sub near-field space T, then *a* is regular and semi simple near-field space, (3) if 'α' is a left regular element of a Γ-semi sub near-field space T, then α is semi simple, (4) if 'α' is a right regular element of a Γ- semi normal sub near-field space T, then *a* is semi simple, (5) if 'α' is a regular element of a Γ- semi normal sub near-field space T, then *a* is semi simple and (6) if 'α' is a intra regular element of a Γ- semi normal sub near-field space T, then α is semi simple. It is also proved that if α is an element of a duo Γ-semi normal sub near-field space, then (1) α is regular (2) α is left regular, (3) α is right regular, (4) α is intra regular, (5) α is semi simple, are equivalent.

Definition 2.1: An element *a* of Γ- semi sub near-field space S is said to be a *α-idempotent* provided $a\alpha a = a$.

Note 2.2: The set of all α-idempotent elements in a Γ- semi sub near-field space S is denoted by E_α.

Definition 2.3: An element *a* of Γ- semi sub near-field space S is said to be an idempotent or Γ-idempotent if $a\alpha a = a$ for all $\alpha \in \Gamma$.

Note 2.4: In a Γ- semi sub near-field space S, *a* is an idempotent iff *a* is an α-idempotent for all $\alpha \in \Gamma$.

Note 2.5: If an element *a* of Γ- semi sub near-field space S is *an* idempotent, then $a\Gamma a = a$.

We now introduce an idempotent Γ-semi sub near-field space and a strongly idempotent Γ- semi sub near-field space.

Definition 2.6: A Γ- semi sub near-field space S is said to be an *idempotent Γ*- semi sub near-field space provided every element of S is α –idempotent for some $\alpha \in \Gamma$.

Definition 2.7: A Γ- semi sub near-field space S is said to be a *strongly idempotent Γ*- semi sub near-field space provided every element in S is an idempotent.

We now introduce a special element which is known as mid unit in a Γ- semi sub near-field space.

Definition 2.8: An element *a* of Γ- semi sub near-field space S is said to be a mid unit provided $x\Gamma a\Gamma y = x\Gamma y$ for all $x, y \in S$.

Note 2.9: Identity of a Γ- semi sub near-field space S is a mid unit.

We now introduce an *r*-element in a Γ- semi sub near-field space and also a generalized commutative Γ- semi sub near-field space.

Definition 2.10: An element '*a*' of Γ- semi sub near-field space S is said to be an r-element provided $a\Gamma s = s\Gamma a$ for all $s \in S$ and if $x, y \in$ S, then $a\Gamma x\Gamma y = b\Gamma y\Gamma x$ for some $b \in$ S.

Definition 2.11: A Γ- semi sub near-field space S with identity 1 is said to be *a* generalized commutative Γ- semi sub near-field space provided 1 is an r-element in S.

Theorem 2.12: Every generalized commutative Γ- semi sub near-field space is a left duo Γ- semi sub near-field space.

Proof: Let S be a generalized commutative Γ- semi sub near-field space. Therefore 1 is an r-element.

Let A be a left Γ- sub near-field space of S. Let $x \in$ A and s ∈ S.

Now $x\Gamma s = 1\Gamma x\Gamma s = b\Gamma s\Gamma x = (b\Gamma s)\Gamma x \subseteq A$. Therefore A is a Γ-sub near-field space of S.

Therefore S is a left duo Γ- semi sub near-field space.

As an author, I Dr N V Nagendram now introduces a regular element in a Γ- semi sub near-field space and regular Γ- semi sub near-field space.

Definition 2.13: An element a of a Γ- semi sub near-field space S is said to be regular Γ- semi sub near-field space provided $a = a\alpha x\, \beta a$, for some $x \in$ S and $\alpha, \beta \in \Gamma$. i.e, $a \in a\Gamma S\Gamma a$.

Definition 2.14: A Γ- semi sub near-field space S is said to be *a* regular Γ- semi sub near-field space provided every element is regular.

Example 2.15: Let S be the set of 3×2 matrices and Γ be a set of some 2×3 matrices over of field. Then S is a regular Γ- semi sub near-field space.

Verification: Let A ∈ S, where A = $\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix}$

Then we chose B ∈ Γ according to the following cases such that ABABA = ABA = A.

Case-1: When the sub matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is non-singular, then $ad - bc \neq 0$.

e, f may both be 0 or one of them is 0 or both of them are non-zero.

then B = $\begin{bmatrix} \frac{d}{ad-bc} & \frac{-b}{ad-bc} & 0 \\ \frac{-c}{ad-bc} & \frac{a}{ad-bc} & 0 \end{bmatrix}$ and we find ABA = A.

Case-2: $af - be \neq 0$. Then B = $\begin{bmatrix} \frac{f}{af-be} & 0 & \frac{-b}{af-be} \\ \frac{-e}{af-be} & 0 & \frac{a}{af-be} \end{bmatrix}$ and ABA = A.

Case-3: $cf - de \neq 0$. Then B = $\begin{bmatrix} 0 & \frac{f}{cf-de} & \frac{-d}{cf-de} \\ 0 & \frac{-e}{cf-de} & \frac{c}{cf-de} \end{bmatrix}$ and ABA = A.

Case-4: When the sub matrices are singular, then either $\begin{cases} ad-bc=0 \\ cf-be=0 \end{cases}$ *or* $\begin{cases} ad-bc=0 \\ af-de=0 \end{cases}$.

If all the elements of A are 0, then the case is trivial. Next we consider at least one of the elements of A is non-zero, say $a_{ij} \neq 0$, i =1, 2, 3 and j =1, 2. Then we take the b_{ji} th element of B as $(a_{ij})^{-1}$ and the other elements of B are zero and we find that ABA = A. Thus A is regular. Hence S is a regular Γ- semi sub near-field space.

Theorem 2.16: Every α-idempotent element in a Γ- semi sub near-field space is regular Γ- semi sub near-field space.

Proof: Let a be an α-idempotent element in a Γ- Γ- semi sub near-field space S. Then $a = a\alpha a$ for some $\alpha \in \Gamma$. Hence $a = a\alpha a\alpha a$. Therefore a is a regular element.

Example 2.17: Let S = {0, a, b} and Γ be any nonempty set. If we define a binary operation on S as the following Cayley's table, then S is a Γ- semi sub near-field space.

.	0	a	b
0	0	0	0
a	0	a	a
b	0	b	b

Define a mapping from S × Γ × S to S as $a\alpha b = ab$ for all $a, b \in$ S and $\alpha \in \Gamma$. Then S is regular Γ- semi sub near-field space.

We now introduce a regular Γ-ideal of a Γ-semigroup.

Definition 2.18: A Γ-sub near-field space A of a Γ- semi sub near-field space S is said to be regular Γ- semi sub near-field space if every element of A is regular in A.

Theorem 2.19: Every Γ-sub near-field space of a regular Γ- semi sub near-field space S is a regular Γ-sub near-field space of S.

Proof: Let A be a Γ-sub near-field space of S and $a \in$ A. Then $a \in$ S and hence a is regular Γ- semi sub near-field space in S.

Therefore $a = a\alpha b\beta a$ where $b \in$ S and $\alpha, \beta \in \Gamma$.

Hence $a = a\alpha b\beta a = (a\alpha b\beta)(a\alpha b\beta a) = a\alpha[(b\beta a)\alpha b]\beta a$.

Let $b_1 = (b\beta a)\alpha b \in S\Gamma A\Gamma S \subseteq A$.

Now $a\alpha b_1\beta a = a\alpha[(b\beta a)\alpha b]\beta a = a$.

Therefore a is regular Γ- semi sub near-field space in A and hence A is a regular Γ-sub near-field space.

This completes the proof of the theorem.

Theorem 2.20: If a Γ- semi sub near-field space S is a regular Γ- semi sub near-field space then every principal Γ-sub near-field space is generated by a β-idempotent for some $\beta \in \Gamma$.

Proof: Suppose that S is a regular Γ- semi sub near-field space. Let $< a >$ be a principal Γ-sub near-field space of S.

Since S is a regular Γ- semi sub near-field space, there exists $x \in$ S, $\alpha, \beta \in \Gamma$ such that $a = a\alpha x\beta a$.

Let $a\alpha x = e$. Then $e\beta e = (a\alpha x)\beta(a\alpha x) = (a\alpha x\beta a)\alpha x = a\alpha x = e$.

Thus e is a β-idempotent element of S.

Now $a = a\alpha x\beta a = e\beta a \in < e > \Rightarrow < a > \subseteq < e >$.

Also $e = a\alpha x \in < a > \Rightarrow < e > \subseteq < a >$.

Therefore $< a > = < e >$ and hence every principal Γ-sub near-field space is generated by an idempotent.

We now introduce left regular element, right regular element, completely regular element in a Γ-semi sub near-field space and completely regular Γ- semi sub near-field space.

Definition 2.21: An element a of a Γ- semi sub near-field space S is said to be left regular Γ-semi sub near-field space provided $a = a\alpha a\beta x$, for some $x \in$ S and $\alpha, \beta \in \Gamma$. i.e, $a \in a\Gamma a\Gamma S$.

Definition 2.22: An element a of a Γ- semi sub near-field space S is said to be right regular Γ-semi sub near-field space provided $a = x\alpha a\beta a$, for some $x \in$ S and $\alpha, \beta \in \Gamma$. i.e, $a \in S\Gamma a\Gamma a$.

Definition 2.23: An element a of a Γ- semi sub near-field space S is said to be completely regular Γ-semi sub near-field space provided, there exists an element $x \in S$ such that $a = a\alpha x\beta a$ for some $\alpha, \beta \in \Gamma$ and $a\alpha x = x\beta a$ i.e., $a \in a\Gamma x\Gamma a$ and $a\Gamma x = x\Gamma a$.

Definition 2.24: A Γ- semi sub near-field space S is said to be completely regular Γ- semi sub near-field space provided every element of S is completely regular.

We now introduce (α, β)-inverse of an element in a Γ- semi sub near-field space.

Definition 2.25: Let S be a Γ- semi sub near-field space, $a \in S$ and $\alpha, \beta \in \Gamma$. An element $b \in S$ is said to be an (α, β)-inverse of a if $a = a\alpha b\beta a$ and $b = b\alpha a\beta b$.

Theorem 2.26: Let S be a Γ- semi sub near-field space and $a \in S$. Then a is a regular element if and only if a has an (α, β)-inverse.

Proof: Suppose that a is a regular element. Then $a = a\alpha b\beta a$ for some $b \in S$ and $\alpha, \beta \in \Gamma$.

Let $x = b\beta a\alpha b \in S$.

Now $a\alpha x\beta a = a\alpha(b\beta a\alpha b)\beta a = (a\alpha b\beta a)\alpha b\beta a = a\alpha b\beta a = a$ and
$x\beta a\alpha x = (b\beta a\alpha b)\beta a\alpha (b\beta a\alpha b) = b\beta(a\alpha b\beta a)\alpha (b\beta a\alpha b) = b\beta a\alpha(b\beta a\alpha b) = b\beta(a\alpha b\beta a)\alpha b = b\beta a\alpha b = x$.
Therefore $x = b\beta a\alpha b$ is the (α, β)-inverse of a.

Conversely suppose that b is an (α, β)-inverse of a.
Then $a = a\alpha b\beta a$ and $b = b\beta a\alpha b$. Therefore $a = a\alpha b\beta a$ and hence a is regular.

This completes the proof of the theorem.

We now introduce a semi simple element of a Γ- semi sub near-field space and a semi simple Γ- semi sub near-field space.

Definition 2.27: An element a of Γ- semi sub near-field space S is said to be semi simple provided $a \in < a > \Gamma < a >$, that is, $< a > \Gamma < a > = < a >$.

Definition 2.28: A Γ- semi sub near-field space S is said to be semi simple Γ- semi sub near-field space provided every element of S is a semi simple element.

We now introduce an intra regular element of a Γ- semi sub near-field space.

Definition 2.29: An element a of a Γ- semi sub near-field space S is said to be intra regular provided $a = x\alpha a\beta a\gamma y$ for some $x, y \in S$ and $\alpha, \beta, \gamma \in \Gamma$.

Example 2.30: The Γ- semi sub near-field space Let S = {0, a, b} and Γ be any nonempty set. If we define a binary operation on S as the following Cayley's table, then S is a Γ- semi sub near-field space.

.	0	a	b
0	0	0	0
a	0	a	a
b	0	b	b

Define a mapping from $S \times \Gamma \times S$ to S as $a\alpha b = ab$ for all $a, b \in S$ and $\alpha \in \Gamma$. Then S is regular Γ- semi sub near-field space is an intra regular Γ-semigroup.

Theorem 2.31: If 'a' is a completely regular element of a Γ- semi sub near-field space S, then a is regular and semi simple.

Proof: Since a is a completely regular element in the Γ- semi sub near-field space S, $a = a\alpha x\beta a$ for some $\alpha, \beta \in \Gamma$ and $x \in S$. Therefore a is regular.

Now $a = a\alpha x\beta a \in a\Gamma x\Gamma a \subseteq < a > \Gamma < a >$. Therefore a is semi simple. This completes the proof of the theorem.

Theorem 2.32: If 'a' is a completely regular element of a Γ- semi sub near-field space S, then a is both a left regular element and a right regular element.

Proof: Suppose that a is completely regular. Then $a \in a\Gamma S\Gamma a$ and $a\Gamma S = S\Gamma a$.

Now $a \in a\Gamma S\Gamma a = a\Gamma a\Gamma S$. Therefore a is left regular. Also $a \in a\Gamma S\Gamma a = S\Gamma a\Gamma a$. Therefore a is right regular.This completes the proof of the theorem.

Theorem 2.33: If 'a' is a left regular element of a Γ- semi sub near-field space S, then a is semi simple.

Proof: Suppose that a is left regular. Then $a \in a\Gamma a\Gamma x$ and hence $a \in < a > \Gamma < a >$. Therefore a is semi simple. This completes the proof of the theorem.

Theorem 2.34: If 'a' is a right regular element of a Γ- semi sub near-field space S, then a is semi simple.

Proof: Suppose that a is right regular. Then $a \in a\Gamma a\Gamma x$ and hence $a \in < a > \Gamma < a >$. Therefore a is semi simple. This completes the proof of the theorem.

Theorem 2.35: If 'a' is a regular element of a Γ-semigroup S, then a is Semi simple.

Proof: Suppose that a is regular element of Γ-semigroup S. Then $a = a\alpha x\beta a$, for some $x \in S$, $\alpha, \beta \in \Gamma$ and hence $a \in < a > \Gamma < a >$. Therefore a is semi simple. This completes the proof of the theorem.

Theorem 2.36: If 'a' is a intra regular element of a Γ- semi sub near-field space S, then a is semi simple.

Proof: Suppose that a is intra regular. Then $a \in x\Gamma a\Gamma a\Gamma y$ for $x, y \in S$ and hence $a \in < a > \Gamma < a >$ Therefore a is semi simple. This completes the proof of the theorem.

Theorem 2.37: If S is a duo Γ- semi sub near-field space, then the following are equivalent for any element $a \in S$.
1) a is regular.
2) a is left regular.
3) a is right regular.
4) a is intra regular.
5) a is semisimple.

Proof: This can proved by cyclic method of proof. Since S is duo Γ- semi sub near-field space, $a\Gamma S_1 = S_1\Gamma a$.
We have $a\Gamma S_1\Gamma a = a\Gamma a\Gamma S_1 = S_1\Gamma a\Gamma a = < a\Gamma a > = < a > \Gamma < a >$.
(1) ⇒ (2): Suppose that a is regular. Then $a = a\alpha x\beta a$ $\forall x \in S$ and $\alpha, \beta \in \Gamma$.
Therefore $a \in a\Gamma S_1\Gamma a = a\Gamma a\Gamma S_1 \Rightarrow a = a\gamma a\ \delta y$ for some $y \in S_1$, $\gamma, \delta \in \Gamma$.
Therefore a is left regular.

(2) ⇒ (3): Suppose that a is left regular. Then $a = a\alpha a\beta x$ for some $x \in S$ and $\alpha, \beta \in \Gamma$.
Therefore $a \in a\Gamma a\Gamma S_1 = S_1\Gamma a\Gamma a \Rightarrow a = y\ \gamma a\delta a$ for some $y \in S_1$, $\gamma, \delta \in \Gamma$.
Therefore a is right regular.

(3) ⇒ (4): Suppose that a is right regular. Then for some $x \in S$, $\alpha, \beta \in \Gamma$; $a = x\alpha a\beta a$. Therefore $a \in S_1\Gamma a\Gamma a = < a\Gamma a >$ $\Rightarrow a = x\alpha a\beta a\gamma y$ for some $x, y \in S_1$ and $\alpha, \beta, \gamma \in \Gamma$. Therefore a is intra regular.

(4) ⇒ (5): Suppose that a is intra regular. Then $a = x\alpha a\beta a\gamma y$ $\forall x, y \in S_1$ and $\alpha,\beta, \gamma \in \Gamma$. Therefore, $a \in < a > \Gamma < a >$. Therefore a is semi simple.

(5) ⇒ (1): Suppose that a is semi simple. Then $a \in < a > \Gamma < a > = a\Gamma S1\Gamma a$
$\Rightarrow a \in a\alpha x\beta a$ for some $x \in S_1$and $\alpha, \beta \in \Gamma$.
Therefore a is a regular element.
This completes the proof of the theorem.

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