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A FLAVOUR OF NON COMMUTATIVE ADVANCE ALGEBRA PART - II

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ABSTRACT

In this paper, A Flavour of Non Commutative Advance Algebra Part-I as we mentioned earlier unlike the case for Nagendram commutative near-field spaces, a non commutative near-field space N used not have a near-field of fractions in which all non zero divisors are invertible. But we claimed that there are alternatives, and we saw that one of these is the maximal Nagendram near-field space of left quotients. Here we shall see that there are other viable choices, all sub near-field spaces of the maximal Nagendram near-field space. It also turns out that these various Nagendram near-field spaces of quotients are characterized by topologies on Nagendram near-field space N and by "torsion" functors on N- sub Nagendram near-field spaces. Here we will give a brief introduction to topologies and torsion theories for N and give some indication of how they are connected. As a bonus we also characterize Nagendram commutative near-field spaces, a non commutative near-field space N of left quotients. Those characterizations are due to Dr N V Nagendram who published them in a series of papers in the academic year of 2019 -2020. This is the final part of a short two-part write-up on non commutative advanced algebra.

SECTION-1: TOPOLOGIES; AND TORSION THEORY ON NAGENDRAM COMMUTATIVE NEAR-FIELD SPACES, A NON COMMUTATIVE NEAR-FIELD SPACES

1.1 Definition: Topology or a Nagendram topology or an additive topology. A non-empty set τ of left Nagendram sub near-field spaces of N is said to be a Topology or a Nagendram topology or an additive topology for N in case it satisfies both the two propoerties below mentioned: (p.1) $\forall$ D $\in \tau$ and all a $\in$ N, (D : a) $\in \tau$; (p.2)

Let τ be a left sub Nagendram near-field space of N and D $\in \tau$. If (I : d) $\in \tau$ for all d $\in$ D, then I $\in \tau$.

1.2 Note: The set D of all dense left sub Nagendram near-field spaces of a Nagendram near-field space N is a topology for N.

1.3 Definition: Filter. The topology D is sometimes called a flter of left Nagendram sub near-field spaces for N.

1.4 Definition: Pre-Topology. A non empt collection τ of left sub Nagendram near-field spaces of N is a pre-topology for N in case it satisfies the following properties:
(p.3) for all D $\in \tau$ and all a $\in$ N, (D : a) $\in \tau$; (p.4) If D $\leq$ I $\leq$ N and D $\in \tau$, then I $\in \tau$ and
(p.5) If D_1, $D_2 \in \tau$ then $D_1 \cap D_2 \in \tau$.

1.5 Definition: τ-pre-torsion sub Nagendram near-field space. Let τ be a pre topology for N. Then for each left $_N$M sub Nagendram near-field space, define $\tau_\gamma(M)$ = { x $\in$ M : (u : x) $\in \tau$ }. The sub Nagendram near-field space $\tau_\gamma(M)$ is called the τ-pre-torsion sub Nagendram near-field space of M, If τ is a topology, then $\tau_\gamma(M)$ is the τ-torsion sub Nagendram near-field space of M.

1.6 Definition: τ-torsion class. If τ is a topology, then the sub Nagendram near-field spaces in the class τ_γ are known as the τ-torsion sub Nagendram near-field spaces and τ_γ as the τ-torsion class.

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1.7 Definition: τ-torsion free. If τ is a topology for Nagendram near-field space N, a sub Ngendram near-field space $_N$M is τ-torsion free in case $\tau_\gamma(M) = 0$.

1.8 Definition: τ-torsion free class. The class $F_\gamma = \{M \in {_N}SNF: \tau_\gamma(M) = 0\}$, where SNF is sub nagendram near-field space and of all τ-torsion free sub Nagendram near-field spaces is a τ-torsion free class.

1.9 Definition: torsion thoery generated by a non empty class of left N sub Nagendram near-field spaces. Let C be a non-empty class of left N-sub Nagendram near-field spaces. Set F = $\{_N N : Hom_N(C,N) = 0$ for all $C \in$ **C**$\}$ and T = $\{_N M: Hom_N(M, N) = 0$ for all $N \in$ **F**$\}$ The pair (T, F) is the torsion thoery generated by a non empty class **C** of left N sub Nagendram near-field space N.

1.10 Definition: τ–injective Test Lemma. Let τ be a topology for N. A left N-sub Nagendram near-field space N τ–injective if Hom $_N(-V)$ is exact on all short exact sequences $0 \to K \to M \to N \to 0$ with N τ–torsion. Then an N sub Nagendram near-field space V is τ–injective if and only if every $D \in \tau$ and every N-near-field homomorphism $e : D \to V$ there is an extension $\bar{e} : N \to V$ is known as τ–injective Test Lemma.

SECTION-2: SOME RESULTS ON TOPOLOGIES; AND TORSION THEORY OF NAGENDRAM COMMUTATIVE NEAR-FIELD SPACES, A NON COMMUTATIVE NEAR-FIELD SPACES.

In this section, we study and derive main results on Topologies; and Torsion theory of Nagendram commutative near-field spaces, a non commutative near-field spaces.

2.1 Theorem: The set **D** of all dense left sub Nagendram near-field spaces of a Nagendram near-field space N is a topology for N.

Proof: To prove this theorem by the help of below note and lemma:

2.1.1 Note: as if N is commutative Nagendram near-field space, then its maximal Nagendram near-field space Q of left quotients is isomorphic to the outer of S = End($_N$E). In particular, Q is commutative Nagendram near-field space.

2.1.2 Lemma: Let $I \leq N$ be a left sub Nagendram near-field space and let $D \in$ **D** be dense. If $(I : d) \in$ **D** for each $d \in$ **D** then $I \in$ **D.**

Proof: Let $b \in N$: we claim that $_n$N(I : b) = 0. so by every left sub Nagendram near-field space I of N we have statements which are equivalents (a) $I \in$ **D** (b) there is a $D \in$ **D** such that nN (I : d) = 0 for all $d \in$ **D** and (c) for every $d \in$ **D,** nN (I : d) = 0. So we would have that I is dense.

Suppose that $x \in N$ is not zero ($\neq 0$). since D is dense, we have that every left sub Nagendram near-field space $D \leq N$ that is dense in N is essential in N. That is (D : x) = In(x) so that nN(D : x) = $n_N I_N(x)$ implies that (D : b)x $\neq 0$, say that $nb \in D$ and $nx \neq 0$. But $nb \in D$, so (I : nb) $\in$ **D**, and (I : nb) nx $\neq 0$ thereby 2.1.1 note. However (I : nb)n $\subseteq$ (I : b), so (I : b)x $\neq 0$ since this holds good for all $b \in N$, we have $I \in$ **D**. This completes the proof of the lemma hence proved the theorem.

2.2 Proposition: A non empt collection τ of left sub Nagendram near-field spaces of N is a topology then for $N \in \tau$ and (p.3) If $D \leq I \leq N$ and $D \in \tau$, then $I \in \tau$ and (p.4) If $D_1, D_2 \in \tau$ then $D_1 \cap D_2 \in \tau$.

Proof: Since τ is non empty, there is some $D \in \tau$ and $0 \in D$. So by (p.1), N = (D: 0)$\in \tau$. For (p.3) suppose that $I \leq D \leq N$ and $D \in \tau$. Then (I : d) = $N \in \tau$ for all $d \in D$, so by (p.2), $I \in \tau$. Finally, for (p.4) we have $(D_1 \cap D_2 : d) = (D_1 : d) \in \tau$ for all $d \in D_2$. So by (p.2) $D_1 \cap D_2 \in \tau$. This completes the proof of the proposition.

2.3 Theorem: The collection ε of all essential left sub Nagendram near-field spaces of N is a pre -topology for N.

Proof: Since ε clearly satisfies (p.3) and (p.4), it will survive to prove that it satisfies (p.1). So suppose that $D \leq N$, that $b \in N$ and that $Nx \cap (D : b) = 0$. If $x \neq 0$ then clearly $Nxb \neq 0$. Hence $Nxb \cap D \neq 0$ and there is a non-zero $nxb \in D$. But then $0 \neq nx \in (D : b)$ a contradiction.

Let τ be a pre-topology for N. Then for each left $_N$M sub Nagendram near-field space, define $t\gamma(M) = \{x \in M : (0 : x) \in \tau\}$. Observe that $t\gamma(M)$ is both left and right sub Nagendram near-field space and if $x, y \in t\gamma(M)$, then (0 : x), (0 : y) $\in \tau$ and it implies $(0 : x + y) \supseteq (0 : x) \cap (0 : y)$. So by (p.3) and (p.4), $(0 : x + y) \in \tau$. So $x + y \in \tau\gamma(M)$. Also if $x \in M$, $b \in N$ and $s \in S$, then $(0: bxs) = \{(0 : xs) : a\} \in \tau$ by (p.1), so $bxs \in \tau\gamma(M)$. This completes the proof of the theorem.

2.4 Note: With the notation, Set $F = \{_N N : Hom_N(C,N) = 0$ for all $C \in C\}$ and $T = \{_N M: Hom_N(M,N) = 0$ for all $N \in F\}$ The pair (T, F) is the torsion theory generated by a non empty class C of left N sub Nagendram near-field space N. Suppose C is closed under left sub Nagendram near-field spaces and factor Nagendram near-field spaces. Then there is a topology τ for N such that $\tau = \tau_\gamma$ and $F = F_{\gamma.,}$ where F is closed under injective envelopes and we can consider the injective envelopes of cycle sub Nagendram near-field spaces in F of a near-field space N.

2.5 Note: Let K be a non-zero cyclic Z-sub Nagendram near-field space, let L = L(K) be its injective envelope, and let τ be the topology on Z generated by L. Then the regular sub Nagendram near-field space Z is τ torsion free.

2.6 Note: Let N be P. I. D., and let Q be the set of all prime sub Nagendram near-field spaces of N. For each of the following injective N-sub Nagendram near-field spaces L, describe the sub Nagendram near-field spaces in the topology $\tau = \tau_L$ and the class τ_γ of τ torsion sub Nagendram near-field spaces. (a) for some $q \in Q$ let L = L(N/(q)); (b) For some $q \in Q$, let $L = \Pi_{q \in Q} \{L(N/p) : p \neq q\}$.

2.7 Note: Let τ be a topology for Nagendram near-field space N. Then the set $U = \{x + D: x \in N$ and $D \in \tau\}$ is a system of neighbourhoods for a topology on N relative to which the operations of addition and multiplication are continuous maps $N \times N \rightarrow N$ and the operation of negation is a continuous map $N \rightarrow N$.

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