**CONSTRUCTION OF SOME ALGEBRAIC STRUCTURES USING**

**THE SET OF LOUBR MAGIC SQUARES**

**By**

**BABAYO, MUHAMMED ABDULLAHI**

**DEPARTMENT OF MATHEMATICS,**

**AHMADU BELLO UNIVERSITY,**

**ZARIA, NIGERIA**

**NOVEMBER, 2015**

**CONSTRUCTION OF SOME ALGEBRAIC STRUCTURES USING**

**THE SET OF LOUBR MAGIC SQUARES**

**By**

**BABAYO, MUHAMMED ABDULLAHI**

**B.SC. (G.S.U; 2009)**

**MSC / SCIE / 33369 / 2012 – 2013**

**A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY IN PARTIAL FULFILMENT FOR THE AWARD OF MASTER OF SCIENCE IN MATHEMATICS**

**DEPARTMENT OF MATHEMATICS,**

**AHMADU BELLO UNIVERSITY,**

**ZARIA, NIGERIA**

**NOVEMBER, 2015**

**DECLARATION**

I declare that the work in this dissertation titled ‘Construction of Some Algebraic Structures Using the Set of Loub Magic Squares’ has been carried out by me in the Department of Mathematics under the supervision of Prof. G. U. Garba and Prof. M. A. Khan.

The information derived from the literature has been duly acknowledged in the text and a list of references is provided. No part of this dissertation was previously presented for another degree or diploma at this or any other University.

BABAYO, Muhammed Abdullahi \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name of Student Signature Date

**CERTIFICATION**

This dissertation titled “CONSTRUCTION OF SOME ALGEBRAIC STRUCTURES USING THE SET OF LOUB MAGIC SQUARES’’ by BABAYO, MUHAMMED ABDULLAHI, meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Prof. G. U. Garba Date

Chairman, Supervisory Committee

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Prof. M. A. Khan Date

Member, Supervisory Committee

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Prof. B. A. Madu Date

External Examiner

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Prof. B. Sani Date

Head of Department

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Prof. K. Bala Date

Dean, School of Postgraduate Studies

DEDICATION

To my post humous father, Alh. Babayo Abdullahi Sadiq who died on the 24th of October, 2015

**ACKNOWLEDGEMENTS**

My unreserved gratitude goes to my main dissertation supervisor, Prof. G.U. Garba. He, in spite of his academic, management, administrative and personal workload, rendered me a complete scholarly supervision. His constructive criticisms made this dissertation a successful one. It is therefore no exaggeration to say that without a person of his own intellectual standing, so convincing in his suggestions and directives, this dissertation would never have reached completion. Also, my warm extension of unreserved gratitude goes to Prof. M.A. Khan, my second supervisor.

My deep extension of profound gratitude goes to: Prof. B. Sani, Prof. S. B. Junaidu , Prof. Y. Haruna, Prof. J. Singh, Prof. D. Singh, Prof. B. K. Jha, Dr.(Mrs) A. Umar, Dr. A. M. Ibrahim, Dr. A. Yahaya, Dr. A. Khattab, Dr. M. Yaquot, Dr. A. Mohammed, Dr. A. Bashir, Dr. H. M. Jibril, Dr. H. G. Dikko, Dr. A. Alkali, Dr. A. I. Fulatan, Dr. Y. M. Baraya, Mal. A. T. Imam and all staff of the Department of Mathematics, Ahmadu Bello University, Zaria as well as all the staff of G.S.U; N.M.C; F.U.K; I.Q.M.I.C; I.M.S.A; W.V.P.S; and F.G.C. Azare.

I have to also record thanks to the following people: Dr. Abubakar Aliyu Ba Feto, the Registrar of the Federal University, Kashere; (Dr.) Bala Bello Tinka, the Manager, Tinka Point, Gombe State; Alh. Inuwa Garba, the Former Speaker of Gombe State; Dr. Mohammed Sani Gumel , the Former Dean, Faculty of Science, FUK, Gombe and Prof. Bello Abdullahi, the Dean, Faculty of Science, FUK, Gombe.

I would like to acknowledge the following people with greatest appreciation for their memorable outstanding efforts in inculcating mathematics into my academic life: Prof. Yahuza Bello , Prof. Mishra, Prof. Solarin, Prof. Kuku, Prof. Ilorin, Prof. Adetunmobi, Prof. Dauda, Prof. Omosigbo, Prof. Adetula, Prof. Sese, Prof. Onumanyi, Dr. Misra, Dr. Bappah, Dr. Yuguda, Dr. Manjak, Dr. Mishelia , Dr. Wakili, and Mal. Sadissou.

I equally owe thanks to: The President of Gombe State Alumni Association, the Principal of Gombe International School, Alh. S. Yahuza of Ashaka Cement Company, Alh. Y.M. Baba, a Permanent Secretary, Imam A. Lamido of Bolari Central Mosque, and some friends, mathematics authors: Awogbemi, Bashir, Hali and Arzuka.

I feel gratified to recognize the patience, tolerance and understanding of my parents, my wife and my 2 children when this dissertation was on process.

**ABSTRACT**

This dissertation exclusively constructs the theory of algebraic realms semigroups, groups, semirings and fields using the set of Loub Magic Square. For the theory constructing sake, the set of Loub Magic Squares over some multiset of numbers equipped with some chosen binary and unary operations is used to construct some important algebraic structures and it is proved that some other most important algebraic structures are in the aforementioned squares. More so, the Loub Magic Square Algebraic Structures fit the definition of “Good Mathematics” well. The Loub Magic Squares are recognized with centre piece c, magic sum M(S) and eigen value. The set of centre pieces, the set of magic sums and the set of eigen values form respective abelian groups if each of the sets is equipped with the binary operation of integer addition. A refined procedure and a new generalization of the Loub Magic Square are presented. Also; the generalized centre piece formula and magic sum formula of the aforementioned square, and of its composite, are proved.

**TABLE OF CONTENTS**

**Title Page.............................................................................................................................i**

**Declaration.........................................................................................................................iv**

**Certification.......................................................................................................................v**

**Dedication..........................................................................................................................vi**

**Acknowledgements...........................................................................................................vii**

**Abstract............................................................................................................................viii**

**Table of Contents.......................................................................................................ix - xi**

**CHAPTER ONE**

INTRODUCTION AND PRELIMINARIES

* 1. **Introduction.....................................................................................................................1**
  2. Statement of the Problem..................................................................................................3
  3. Background of the Study...................................................................................................4
  4. Scope and Limitation of the Study....................................................................................4
  5. Aim and Objectives of the Study......................................................................................5
  6. Research Methodology.....................................................................................................6
  7. Outline of the Thesis.........................................................................................................6
  8. Significance of the Study.................................................................................................6
  9. Justification of the Study..................................................................................................7
  10. Preliminaries...............................................................................................................8

**CHAPTER TWO**

LITERATURE REVIEW

**2.1. Background Works.................................................................................................22**

2.2. Literature View I.........................................................................................................23

2.3. Literature Review........................................................................................................23

2.4. Our Contributions to Loub Magic Square..............................................................25

2.5. Literature View II........................................................................................................34

2.6. Conclusion...................................................................................................................41

**CHAPTER THREE**

SOME ALGEBRAIC STRUCTURES OVER THE LOUB MAGIC SQUARES

**3.1. Introduction.............................................................................................................42**

3.2. Tetrabonacci Subgroup of Symmetry Group over the Loub Magic Squares…...43

3.3. Symmetry Groups of Odd Lengths over the Loub Magic Squares.......................48

3.4. Transformation Semigroups of Odd Lengths over the Loub Magic Squares.......52

3.5. Rhotrix Subelement Subgroups of the Loub Magic Squares................................58

3.6. Remarks.....................................................................................................................61

3.7. About Methodology………………………………………………………………...61

**CHAPTER FOUR**

CONSTRUCTION OF SEMIGROUPS, GROUPS, SEMIRINGS AND FIELDS USING THE SET OF LOUB MAGIC SQUARES

**4.1. Introduction..................................................................................................................63**

4.2. Loub Magic Squares over Sets () Semigroup and Group..........................64

4.3. Minimum Zero-Centre Pandiagonal Composite Type II(a) Loub Magic Squares over Multiset of Natural Numbers Semiring.........................................................................68

4.4. Loub Magic Squares over Multiset of Rational Numbers Infinite Field.................80

4.5. Composite Loub Magic Squares Infinite Abelian Group Miscellany Case of the Loub Magic Squares Infinite Abelian Group..................................................85

4.6. Type I Composite of Type I Loub Magic Squares Infinite Additive Abelian Group and of Type II Infinite Field..................................................................................................93

4.7. Concrete Examples of the Minimal Bull Eye Composite Loub Magic Square Infinite Additive Abelian Groups........................................................................................101

**CHAPTER FIVE**

**SUMMARY, CONCLUSION AND RECOMMENDATIONS**

5.1. Summary......................................................................................................................110

5.2. Conclusion....................................................................................................................113

5.3. Recommendations........................................................................................................121

**References...........................................................................................................123- 127**