

TABLE OF CONTENTS

CHAPTER	SUBJECT	PAGE
	TITLE	i
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF APPENDICES	x
I	INTRODUCTION	1
	1.1 Soliton Theory and its Historical Background	1
	1.2 Background of the Problem	3
	1.3 Statement of the Problem	4
	1.4 Objectives of Study	4
	1.5 Scope of Study	5
	1.6 Organization of the Dissertation	5
II	LITERATURE REVIEW	6
	2.1 The Birth of Solitons	6
	2.2 Inverse Scattering Transform	7

2.3 A Direct Approach towards Exact Soliton Solutions	7
III HIROTA'S DIRECT METHOD	13
3.1 Fundamental Ideas of Hirota's Direct Method	13
3.2 Essentials of the Direct Method	14
3.3 Hirota's <i>D</i> -operator	18
3.3.1 Definition of the <i>D</i> -operator	18
3.3.2 Properties of the <i>D</i> -operator	19
3.4 The Bilinearization of Nonlinear Differential Equations	22
3.4.1 The Rational Transformation	23
3.4.2 Logarithmic Transformation	26
3.4.3 Bi-logarithmic Transformation	32
IV EXACT SOLITON SOLUTIONS	34
4.1 Korteweg-de Vries (KdV) Equation	34
4.1.1 One-soliton Solutions	36
4.1.2 Two-soliton Solutions	41
4.1.3 Three Soliton Solutions	44
4.1.4 N-soliton Solutions	48
4.2 Kadomtsev-Petviashvili (KP) Equation	52
4.2.1 One-soliton Solutions	52
4.2.2 Two-soliton Solutions	54
4.2.3 Three-soliton Solutions	56
4.2.4 N-soliton Solutions	59
4.3 Modified KdV (mKdV) Equation	60
4.3.1 One-soliton Solutions	60
4.3.2 Two-soliton Solutions	66
4.3.3 Three Soliton Solutions	70
4.3.4 N-soliton Solutions	74

4.4	Sine-Gordon (sG) Equation	77
4.4.1	One-soliton Solutions	77
4.4.2	Two-soliton Solutions	80
4.4.3	Three-soliton Solutions	83
4.4.4	N-soliton Solutions	87
V	SINGULARITY ANALYSIS AND HIROTA'S METHOD	88
5.1	The Painlevé Property and Hirota's Method	88
5.1.1	Korteweg-de Vries (KdV) Equation	89
5.1.2	Modified KdV (mKdV) Equation	94
5.1.3	Nonlinear Schrödinger (nlS) Equation	96
VI	CONCLUSION AND SUGGESTIONS	99
6.1	Conclusion	99
6.2	Suggestions	101
	REFERENCES	102
	APPENDICES	107
	Appendix A	107
	Appendix B	109
	Appendix C	110
	Appendix D	112
	Appendix E	114
	Appendix F	116

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Fundamental Property of the Bilinear Operator	107
B	<i>D</i> -operator in Terms of Derivatives	109
C	Formulas for Rational Transformation	110
D	Formulas for Logarithmic Transformation	112
E	Formulas for Bi-Logarithmic Transformation	114
F	Properties of the Bilinear Derivatives	116