



CONTENTS

Title Page	ii
Approval Page	iii
Declaration Page	iv
Dedication Page	v
Motto Page	vi
PREFACE	vii
LIST OF TABLES	xi
LIST OF FIGURES	xv
NOMENCLATURE	xvi
INTISARI	xvii
ABSTRACT	xviii
I INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	2
1.3 Research Objectives	3
1.4 Research Methods	4
1.5 Literature Review	6
1.6 Research Benefits	8
1.7 Novelty of Research Topics	8
II THEORETICAL BACKGROUND	9
2.1 The Crystal Structure of Graphene	9
2.1.1 The Real Space Structure	9
2.1.2 Reciprocal Lattice Structure of Graphene	10
2.2 Graphene's Tight Binding Model Hamiltonian with Impurities	11



2.2.1	Explicit Calculation of Clean Graphene Using Tight Binding Model	12
2.3	Electronic Transport Properties of Graphene	15
2.4	Landauer - Büttiker Formalism	16
2.5	Electronic Transport Properties in Graphene Semiconducting pn-junction	17
2.6	Simpson's Rule for Numerical Integration	19
III Electronic Transport in Semiconducting Graphene with 2 Dimensional Artificial Model		20
3.1	Artificial Model of Graphene with Impurities	20
3.1.1	Tight Binding Calculation for Graphene with Adatoms Impurity	20
3.2	Transport Properties of Zigzag Graphene Nanoribbon with Impurities	23
3.2.1	Zigzag Nanoribbon Wavefunctions	23
3.2.2	Quantum Scattering in Zigzag Nanoribbon	25
3.2.3	Conductance of Zigzag Graphene Nanoribbon with Impurities	26
3.2.4	Armchair Nanoribbon Wavefunctions	27
3.2.5	Quantum Scattering in Armchair Nanoribbon	29
3.2.6	Conductance of Armchair Nanoribbon with Impurities	30
3.3	Electronic Transport in Graphene Semiconducting pn-junction	30
3.3.1	Fermi Energy in pn-junction transition	30
3.3.2	Wavefunction of Zigzag Nanoribbon pn-junction	31
3.3.3	Wavefunction of Armchair Nanoribbon pn-junction	32
3.3.4	Quantum Scattering in Zigzag Nanoribbon pn-junction	34
3.3.5	Quantum Scattering in Armchair Nanoribbon pn-junction	35
IV Results and Discussion		37
4.1	Dispersion Relation of Graphene with Impurities	37
4.2	Transport Properties of Graphene Nanoribbon	43
4.2.1	Transmission Coefficient of Zigzag Nanoribbon	43
4.2.2	Transmission Coefficient of Armchair Nanoribbon	46
4.2.3	Conductance of Zigzag Nanoribbon	49
4.2.4	Conductance of Armchair Nanoribbon	51
4.3	Electronic Transport in Semiconducting Graphene pn-junction	52
4.3.1	Transmission Coefficient of Zigzag Nanoribbon pn-junction.	52
4.3.2	Transmission Coefficient of Armchair Nanoribbon pn-junction.	55



V Conclusion and Suggestion	59
5.1 Conclusion	59
5.2 Suggestions	60
BIBLIOGRAPHY	61
APPENDIX	63
A Appendix: Explicit Calculations	63
A.1 Tight Binding Calculation for Graphene with Impurities : Proof of Equation 3.8	63
A.2 Zigzag Nanoribbon with Impurities: Proof of Equations 3.14 and 3.15	64
A.3 Armchair Nanoribbon with Impurities: Proof of Equations 3.27 and 3.28	66
A.4 Conductance of Zigzag Nanoribbon	69
A.5 Conductance of Armchair Nanoribbon	70
A.6 Zigzag Nanoribbon pn-junction wavefunctions: Proof of Equation 3.45	72
A.7 Armchair Nanoribbon pn-junction wavefunctions: Proof of Equation 3.47	73