

# CONTENTS

<b>APPROVAL PAGE</b>	
<b>SELF DECLARATION AGAINST PLAGIARISM</b>	
<b>ABSTRACT</b>	<b>i</b>
<b>ACKNOWLEDGMENTS</b>	<b>ii</b>
<b>PREFACE</b>	<b>iii</b>
<b>CONTENTS</b>	<b>iv</b>
<b>LIST OF FIGURES</b>	<b>vi</b>
<b>LIST OF NOTATIONS</b>	<b>vii</b>
<b>ACHIEVEMENTS</b>	<b>ix</b>
<b>1 INTRODUCTION</b>	<b>1</b>
1.1 Background . . . . .	1
1.2 Problem Identification . . . . .	2
1.3 Objective and Contributions . . . . .	3
1.4 Scope of Work . . . . .	3
1.5 Research Methodology . . . . .	3
1.6 Organization of The Thesis . . . . .	4
<b>2 BASIC CONCEPT</b>	<b>6</b>
2.1 Digital Communication System Model . . . . .	6
2.1.1 Transmitter . . . . .	6
2.1.2 Receiver . . . . .	7
2.2 LDPC Codes . . . . .	7
2.2.1 Degree Distribution of LDPC Codes . . . . .	7
2.2.2 Parity Check and Generator Matrix Correlation . . . . .	8
2.2.3 Encoding of LDPC Codes . . . . .	10
2.2.4 Decoding of LDPC Codes . . . . .	10
2.3 Sum Product Algorithm for LDPC . . . . .	10

2.4	Hybrid-ARQ Scheme . . . . .	11
2.5	Narrowband Channel . . . . .	12
2.5.1	Capacity and SNR of AWGN Channel . . . . .	13
2.5.2	Capacity and SNR of Fading Channel . . . . .	13
2.6	EXIT chart for AWGN channel . . . . .	13
2.7	Theoretical BER Performances . . . . .	15
<b>3</b>	<b>SYSTEM MODEL AND THE PROPOSED SIR-HARQ</b>	<b>17</b>
3.1	System Model of 5G NR QC-LDPC Codes . . . . .	17
3.1.1	Transmitter . . . . .	18
3.1.2	Channel . . . . .	18
3.1.2.1	AWGN . . . . .	18
3.1.2.2	Rayleigh Fading . . . . .	19
3.1.3	Receiver . . . . .	20
3.2	Factor Graph of 5G NR QC-LDPC Codes . . . . .	22
3.2.1	New Degree Distributions of SIR-HARQ . . . . .	24
3.3	IR HARQ Scheme on 5G NR QC-LDPC Codes . . . . .	26
3.4	Proposed Superposed IR-HARQ Scheme . . . . .	26
3.4.1	EXIT Chart Derivation of SIR-HARQ for AWGN Channel . . . . .	29
<b>4</b>	<b>PERFORMANCE EVALUATIONS</b>	<b>35</b>
4.1	Iteration Pattern for 5G NR QC-LDPC Codes . . . . .	35
4.2	EXIT of QC-LDPC Codes Based on BG1 Without EP . . . . .	35
4.3	EXIT of QC-LDPC Codes Based on BG1 With Full EP . . . . .	37
4.4	BER Performances of QC-LDPC Codes With and Without Full EP Under AWGN Channel . . . . .	38
4.5	EXIT of SIR-HARQ Based on 5G NR QC-LDPC codes . . . . .	40
4.6	BER Performances of SIR-HARQ Under AWGN Channel . . . . .	41
4.7	BER Performances of SIR-HARQ Under Slow Rayleigh Fading Channels . . . . .	42
4.8	BER Performances of SIR-HARQ Under Fast Rayleigh Fading Channels . . . . .	43
<b>5</b>	<b>CONCLUSION</b>	<b>45</b>
5.1	Conclusion . . . . .	45
5.2	Future Works . . . . .	45
	<b>REFERENCES</b>	<b>46</b>