CONTENTS

ENDORSEMENT LETTER

STATEMENT OF ORIGINALITY

ABSTRACT **iv**

Contents **vii**

List of Figures **ix**

List of Tables **x**

1 INTRODUCTION **1**

1.1 Background 1
1.2 Objectives and Benefits 2
1.3 Problem Formulation 2
1.4 Problem Boundary 3
1.5 Research Method 3
1.6 Structure of This Thesis 3
1.7 Time Schedule 4

2 LITERATURE REVIEW **6**

2.1 Ground Penetrating Radar 6
2.1.1 GPR Working Principle 6
2.1.2 GPR System 7
2.1.3 Antenna for GPR application 9
2.1.3.1 Antenna Definition 9
2.1.3.2 GPR Antenna Parameter 9
2.1.3.3 Ultra-Wideband Antenna 10
2.2 Conventional Method 10
2.2.1 Inverse Fourier Transform 11
2.2.2 Least Square Method 11
2.3 Vector Network Analyzer(VNA) 13
2.3.1 Scattering Parameter 14
2.3.2 VNA Measurement 15

3 SYSTEM DESIGN AND EXPERIMENTAL SETUP 16
3.1 System Design 16
3.2 Experimental Setup 17
3.2.1 Laboratory Experiment 18
3.2.1.1 Transmitted signal and Coupling Signal 19
3.2.1.2 Experiment Model 20
3.2.2 Specification System 21

4 RESULT AND ANALYSIS 23
4.1 Result 23
4.1.1 Transmitted Signal and Coupling Signal 23
4.1.2 Received Signal 26
4.1.3 Volumetric Soil Water Content at Three Different Humidity Level 31
4.2 Analysis 31
4.2.1 Accuracy on Volumetric Soil Water Content 32

5 CONCLUSION AND SUGGESTION 33
5.1 Conclusion 33
5.2 Suggestion 33

Bibliography 34