

# CONTENT

<b>APPROVAL PAGE .....</b>	<b>2</b>
<b>ORIGINALITY STATEMENT SHEET .....</b>	<b>3</b>
<b>ABSTRACT.....</b>	<b>4</b>
<b>PREFACE .....</b>	<b>5</b>
<b>CONTENT.....</b>	<b>6</b>
<b>LIST OF FIGURES .....</b>	<b>8</b>
<b>LIST OF TABLES .....</b>	<b>9</b>
<b>CHAPTER 1 .....</b>	<b>10</b>
<b>INTRODUCTION.....</b>	<b>10</b>
1.1    Background .....	10
1.2    Problem Formulation .....	13
1.3    Objective.....	13
1.4    Scope of Work .....	13
1.5    Hypothesis .....	14
1.6    Research Methodology .....	14
1.7    Research Method .....	15
<b>CHAPTER II.....</b>	<b>17</b>
<b>BASIC THEORY .....</b>	<b>17</b>
2.1    Soil Nutrition.....	17
2.2    Ground Penetrating Radar (GPR) and Soil Reflectivity.....	18
2.3    Dielectric Mixture Equation.....	21
2.4    Radar Stepped Frequency Continuous Wave (SFCW).....	22
2.5    Vector Network Analyzer.....	24
2.6    State of The Art.....	26
<b>CHAPTER III .....</b>	<b>31</b>
<b>PROPOSED METHOD.....</b>	<b>31</b>
3.1    Proposed Research.....	31
3.2    SFCW Radar to Detect Soil Nitrogen Content .....	33
<b>CHAPTER IV .....</b>	<b>39</b>
<b>RESEARCH METHODOLOGY .....</b>	<b>39</b>
4.1    Experiment Scenario .....	39
4.2    Data Collection.....	41
<b>CHAPTER V .....</b>	<b>43</b>

<b>RESULTS AND ANALYSIS.....</b>	43
<b>5.1    Radar Validation.....</b>	43
<b>5.2    Comparison Peak to Peak Data and Sensor Invasive.....</b>	44
<b>5.3    Curve Fitting Selection .....</b>	46
<b>5.4    Comparison Estimation and Measurement Result.....</b>	49
<b>CHAPTER VI .....</b>	53
<b>CONCLUSION .....</b>	53
<b>6.1    Conclusion .....</b>	53
<b>6.2    Suggestion.....</b>	53
<b>REFERENCE.....</b>	54
<b>APPENDIX A.....</b>	58
<b>PUBLICATION LIST .....</b>	58
<b>APPENDIX B .....</b>	59
<b>DATA COLLECTION TABLE.....</b>	59
<b>APPENDIX C.....</b>	60
<b>DETECTION RESULT.....</b>	60
<b>APPENDIX D.....</b>	63
<b>POLYNOMIAL CURVE FITTING .....</b>	63
<b>APPENDIX E .....</b>	66
<b>ESTIMATION CURVE USING LOOKUP TABLE.....</b>	66
<b>APPENDIX F .....</b>	68
<b>COMPARISON MEASUREMENT AND ESTIMATION .....</b>	68